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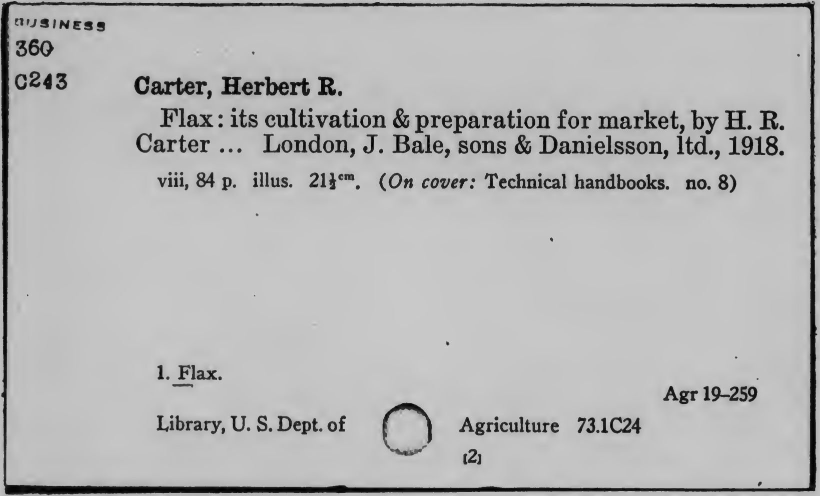

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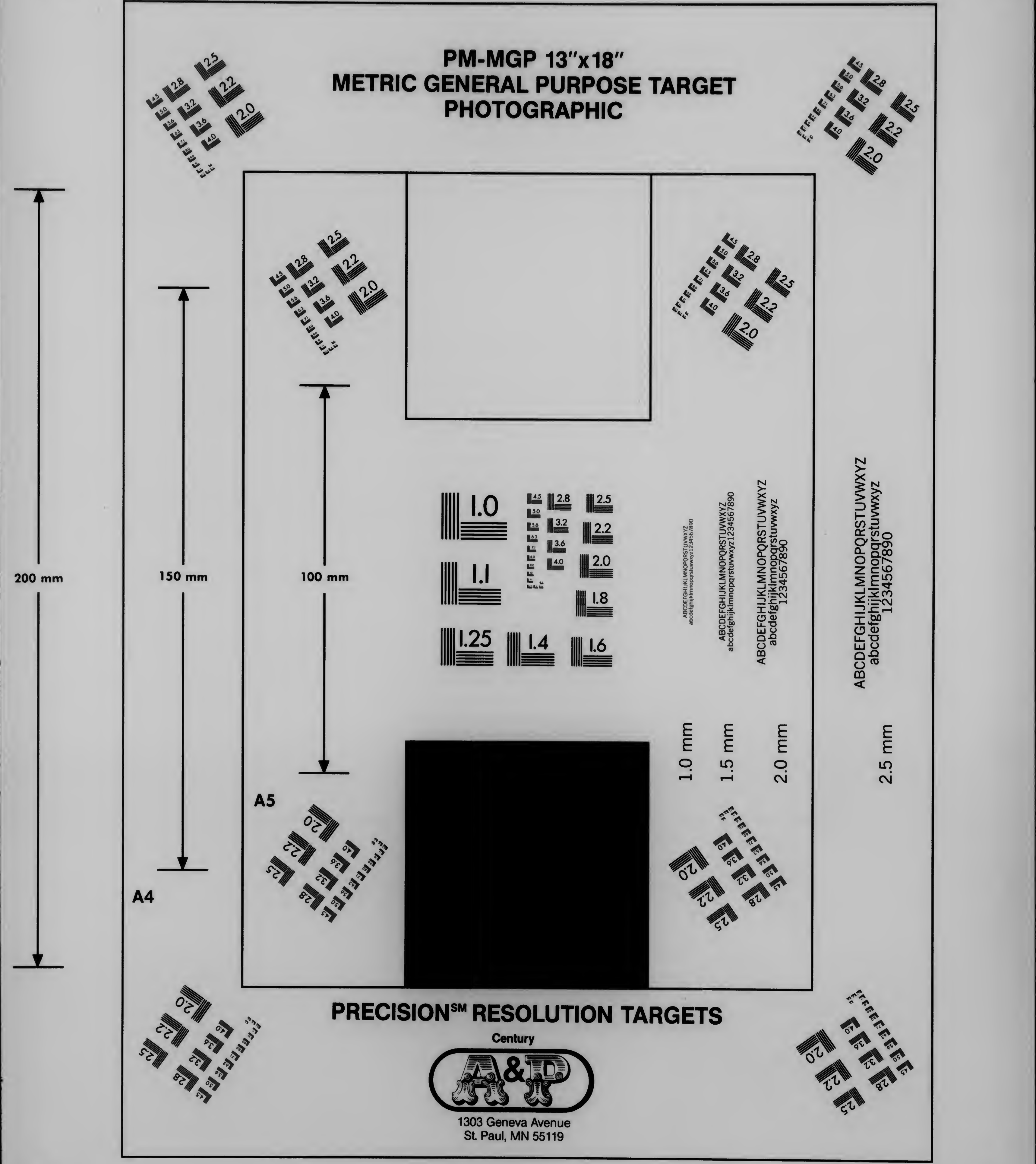

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Its Cultivation & Preparation for Market

BY

H. R. CARTER

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FLAX:

Its Cultivation & Preparation for Market

BY

H. R. CARTER

Author of "Modern Flax, Hemp and Jute Spinning"; "Rope, Twine and Thread Making"; &c., &c.

LONDON
JOHN BALE, SONS & DANIELSSON, LTD.,
OXFORD HOUSE
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PREFACE.

This booklet is being published in the hope that its help may encourage British farmers to grow flax, the national importance of which fibre has recently forced itself into notice. It is absurd that we should only grow about 10 per cent. of the flax we use in our spinning mills, and pay out to foreigners hundreds of thousands of pounds annually for fibre which we might very well grow in our own country.

Flax growing, retting, and scutching is very profitable if properly carried out. Belgian farmers frequently obtain a return of £50 per acre in normal times, and Irish farmers occasionally do quite as well. In the present abnormal times a profit of £85 per acre is possible. Steeping and scutching flax as carried out in Courtrai is also a very remunerative business, almost invariably realizing, if properly conducted, 25 per cent. profit.

H. R. CARTER.

25, *Donegall Street,*
Belfast,
March, 1918.

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INTRODUCTION.

The plant which yields flax fibre is unique in its history. Cultivated for the last 5,000 years or so it has not been replaced by any modern fibre, and present events show that it is indispensable, at least in times of war. At the present day it is one of the most important vegetable products grown in Russia, Austria, Belgium, Holland, Italy, and other European countries, as well as in Egypt, Turkey, India, China and Japan, all over Scotland and many parts of England, and is of course a standard crop in Ulster. In the central Highlands of Scotland "lint pools" can still be traced on many a farm.

Towards the end of the 17th century the cultivation of flax in Fife was carried out on an extensive scale, some 1,500 acres being devoted to the crop, and sufficient fibre produced to meet the demand of the linen manufacturers of the country. There is a traditional aversion in some districts to flax growing, for it has been said to exhaust the soil. There is nothing to prove the soundness of this contention. On the contrary, everything points in the opposite direction. In many districts of Ulster flax is sown on second crop after manuring or what is commonly known as "barley leave," grass and clover seed being put down with the flax. It often happens that the farmer will sow a portion of the same field with oats, but all being put down in grass. The hay crop and grazing following will invariably be much superior on the part flaxed. Not only is this so, but when put down again with oats out of lea, the oat crop will be superior on the portion which was previously under flax. This circumstance is in itself an inducement to many farmers to continue flax growing.

Scotch farmers may be encouraged by the fact that the best crops of flax follow the severest winters, and may be grown on freshly broken upland which has been for several years in grass. As to climate, one inclined rather to cold than heat is the most favourable.

The flax plant is a slender growing annual, 20 to 40 inches in height, with a stem about $\frac{1}{16}$ inch in diameter, with alternate sessile leaves, narrow and lance shaped. It starts from the ground or "comes abraird" with only its two seed leaves developed. It then rises with an upright hollow stem, which divides into branches when grown singly and exposed to light and air, but which runs up straight and slim without scarcely branching at all when it is crowded in its seed bed. It bears a cluster of blue or white flowers on its top, which in time produce capsules having five cells, each containing two flat oily seeds, of a tawny brown colour. In the flowers of the flax plant both stamens and pistils are present, and seed may be expected from every flower except in the case of accident or injury.

FLAX AND ITS CULTIVATION.

CHAPTER I.

CHOICE OF SOIL.

A DEEP sandy loam with clay subsoil is the soil which best suits the flax plant. Maritime districts, especially those which first receive the evaporation of the ocean, such as the East Coast of Scotland, are those in which the flax plant is produced in the greatest perfection. Alluvial deposits of rivers furnish the best fibre. Bog, sandy and gravelly soils have been condemned; yet some of the best Irish lots have been grown on such soils. That flax has been grown successfully on medium or poorer soils is apparent from the fact that it is not in the best districts for land that it is grown most extensively, but rather in the poorer and medium districts. As a general rule, it is on the really good lands that flax growing has been entirely abandoned. Experience shows that an extra rich soil is not a necessity but rather a drawback, from the fact that the flax crop immediately following a manured green crop is seldom as successful as where the soil has been impoverished by an intervening oat or barley crop. Upon poor clays or dry gravelly soils flax will not thrive.

By attention and careful cultivation, good flax may be grown on various soils. It is very desirable that the land should be properly drained and subsoiled, as when it is saturated with either underground or surface water, good flax cannot be expected. An intelligent flax grower, who prepares and manures his land suitably to its nature and situation, will get good flax from almost every quality of soil, but especially from good light land and from clays that are sufficiently intermingled with sand. But soils which are fertile naturally are much better adapted for flax than those which are made so artificially by manure, because they insure a much more even growth.

In Scotland, the best plan that has yet been discovered is to sow oats as a by-crop and flax after it. In 1918 therefore, Scotch farmers taking up flax for the first time, could not do better than sow it where they grew oats in 1917. Where the soil is light and gravelly, flax should be grown after oats following potatoes or turnips, where the ground is heavy with a clay subsoil, after oats following lea.

Flax may also be grown at pleasure and without limit on newly broken up pasture, also when there has been a great deal of trefoil or clover, on the roots of which as they rot in the earth, it supports itself well.

Flax is sometimes sown first crop from lea, but is then very likely to be injured by grub and cannot withstand a prolonged drought as well as if it follows oats for instance. One thing in favour of this lay is that the crop will generally be more clear of weeds than on any other. In some districts flax is successfully grown after a potato crop. In the best soils of Flanders, flax is grown in the third year of a seven-course rotation, or the fifth year of a ten-course rotation. It then invariably follows a corn crop—generally oats—and in Scotland, where oats are a common crop, the same system might be profitably followed.

In Ireland flax is found to thrive best if sown after potatoes, wheat or oats, a good rotation being oats, turnips, wheat, clover grass and potatoes. Flax after potatoes and flax after barley or wheat—the latter crops should be produced after the ground has been manured for potatoes or turnips before flax is cultivated, as either crop will take up the over quantum of matter which would if left in the soil completely spoil all hope of the flax plant being produced either in quantity or fine quality. The wheat or barley stubble when turned down by the plough in October serves as manure for the flax the following year.

CHAPTER II.

PREPARING THE SOIL.

No crop requires the land to be better worked and more thoroughly cleaned than does flax. Light land should be deeply ploughed. On strong and wet land it is desirable to cross plough deeply, or even better to employ spade husbandry. The soil should be soft and well pulverized ; the manure short and quite rotten. Many are fond of street sweepings for the culture of flax or moderate and sandy soils, but others dislike them, on the ground that street sweepings encourage a great deal of darnel to spring up. Careful farmers do not abstain from using them on that account however. They plough their land deeply as soon as the weather permits, then they lay on a liberal allowance of street sweepings and other town muck. They plough it in shallow and leave it so till the end of April ; by that time the weeds have made their appearance, then they give the land a second ploughing, a little deeper than the former one. They give a top dressing of liquid manure, cross harrowing immediately afterwards. In this way they get the better of the weeds and their flax thrives well.

Others make, in autumn, dunghills of vegetable mould mingled with pig muck and farmyard manure. They turn and mix their dunghill well, and as soon as winter is over they plough it in at a slight depth as soon as possible, because the land will already have had a deep ploughing and top dressing either of light soil from the nearest town or of liquid manure from a farmyard tank. Then they pass the harrow over all and proceed with the work in the usual way.

Three points are requisite for success : The land must be thoroughly cleaned, well pulverized and uniformly rich.

The following compound may be successfully used as a manure for flax :—

Bone dust	54 lb.
Sulphate of ammonia	56 ,,
Muriate of potash	30 ,,
Common salt	30 ,,
Burned gypsum	30 ,,

The above quantity is sufficient for a statute acre and should be sown broadcast on the land after the latter has been ploughed and well harrowed and before sowing the seed.

One of the points of the greatest importance in the cultivation of flax is, by thorough draining and by careful and repeated cleansing of the land from weeds, to render the tilth of the finest, deepest and cleanest nature. Room is made for the roots to penetrate, which they will often do to a depth equal to nearly one-half the length of the stem above ground. After wheat one ploughing is often sufficient, but two are generally safest on stiff soils—one in the autumn and one before spring. After oats, when the land has not been thoroughly drained, plough early in autumn, throw it into high ridges, that it may receive the benefit of the frost and air, and make surface drains to carry off the rains of winter. This, however, will not be necessary where thorough draining has been attended to. Plough and harrow very early in spring, and again a month later, to bring the land into good tilth and clean it thoroughly from weeds and roots. Following the last harrowing it is necessary to roll so as to give an even surface and consolidate the loam, breaking this up again with a short-toothed or seed harrow, ere sowing. The ridges should be very little raised in the centre when the ground is ready for the seed, otherwise the crop will not ripen evenly. When land is properly drained there should be no ridges and the seed sown in flat, causing the crop to grow evenly.

The farmer who has had a lengthened practical experience of the characteristics of his soil should be the best judge of when and how to cultivate it. Opinions differ as to whether flax land should be ploughed once or twice. It is a matter which can best be determined by the grower. Ploughing early in autumn and again in spring is the most effectual method of eradicating such weeds as scutch grass, &c., but these weeds are not the most injurious to the crop. Redshank, charlock and spurrey are much more injurious, and growers should study the best means of combating them. Their seed is chiefly introduced from plants grown among the previous oat crop, and it stands to reason that if the land is ploughed shortly after harvest those seeds are covered to such a depth as to completely preserve them through the winter, after which they are ploughed up again to the surface and grow along with the crop, whereas if the land is allowed to lie in stubble until about February before being ploughed, the action of frost, together with the multitude of wild birds which feed on these seeds, effectually dispose of the greater part of them. This method is now being practised to a greater extent than in former years, and the treatment is to be recommended in the case of land which is infested with such weeds.

On light soils plough shallow and on heavy soils deeper. 4 cwt. of kainit per statute acre, applied in the months of January or February, will be found a beneficial application. Muriate or sulphate of potash to the same money value may be substituted. Where seaweed is available and largely used the application of a potassic manure is unnecessary. The use of phosphate manures, i.e., super-phosphates, basic clay, bones or bone compounds, is to be avoided, as these will have the effect of making weed plants, especially "spurrey," grow more luxuriantly and will have no beneficial effect whatever on the flax plant. An application of lime to previous crop in preparation for flax is advantageous, particularly if potash is applied. Sulphate of ammonia (about 56 lb. per acre) has been proved as advantageous on land which would not be likely to produce an overgrowth of straw. Potash should also be applied with this dressing.

Such fertilizers as nitrate of soda generally give a great increase in the bulk of straw, but a decrease in the yield and quality of fibre, consequently the Government will not at this juncture encourage its application.

Experience has proved the use of a potassic manure most beneficial, flax so treated being superior in quality and yield to bulk of straw. Yellowing, which will be referred to later, never occurs when potash has been applied.

CHAPTER III.

FLAX SEED.

FLAX seed is almost too well known to require description. Its skin is smooth and polished and is covered with a kind of mucilage which is readily soluble in hot water. This mucilage, dissolved in water, is popularly used, under the name of flax seed tea, as a soothing drink in various inflammatory diseases. The seeds contain a large quantity of oil and the plant is often cultivated for this product alone.

Sowing seed must be fully matured, heavy, plump and glossy, weighing 52 to 57 lb. per bushel, 1,000 pickles weighing 4·62 grammes. Good Dutch seed will germinate 97 to 100 per cent. Riga seed is lighter and of lower germinating power, being frequently kiln dried. If Riga seed, having a germinating power of not less than 80 per cent., be sown proportionately thicker than Dutch seed, it generally produces heavier flax fibre. Flax fibre produced from Dutch seed is generally of fine quality. Russian seed and Russian seed grown one year in Holland, called Riga child, give excellent results. Many record Irish yields have been produced from Russian seed. Some flax buyers prefer flax grown from Pernan seed to any other.

Russian seed, or rather seed properly matured on plants that grow at proper intervals, ought to be plump, heavy, bright, of a clear brown hue, shining with a greenish lustre and terminating at one end in a blunt little hook, which in fact is the dried-up umbilical cord of the seed, as is seen more clearly when observed under a magnifying glass. It should be smooth and slippery and should sink in water. It should taste sweet when chewed and being broken it should appear of a light greenish yellow colour and very oily.

A good means of testing various samples of seed is to weigh equal measured quantities against each other. Experienced persons examine the seed by taking a handful of it and letting it run out between the forefinger and thumb in order to be able to observe it closely sideways and to be better able to judge of its plumpness and weight. Others moisten their forefinger and dip it into a sample of seed, which sticks to it; they are thus able to examine each grain separately and so form an opinion of its purity and goodness.

Home-grown seed—i.e., seed from drawn-up or not fully ripened plants—is flatter and broader in proportion to its thickness, extremely slippery, running between the fingers like so much quicksilver. Russian seed is not so soft to the touch and is more easily held in the hand. Good seed too should be very even in quality, and free from all mixture with the smaller seeds of weeds.

Most growers prefer to sow new seed, but flax seed preserves its vitality for several years. Indeed, French growers say that home-grown flax seed will grow just as well at the end of ten years as at the first. It is probable that the vital power of foreign seed is more liable to injury during the packing and the journey.

Dutch farmers to the south of Rotterdam make a specialty of producing good sowing seed, for which they obtain good prices on the Rotterdam market.

If Riga seed, having a germinating power of not less than 80 per cent., be sown proportionately thicker than Dutch seed, it generally produces heavier flax fibre. However, the danger of sowing a low germinating seed lies in the fact that if the weather proves warm and seasonable the flax may grow too thick and may be "laid" if rough weather sets in, and the crop lost. If the season is unfavourable, on the other hand, the crop may be a failure owing to the seed not germinating in sufficient quantity, so that on the whole Dutch seed is to be preferred.

Sowing flax seed when bought should be stored in a dry place till sowing time, as no seed absorbs moisture more readily than flax seed, and moisture causes it to lose its vitality. Before sowing it is a good practice to use a wire sieve to take out about 20 per cent. of small seeds. These, if sown, produce a finer stalk, which does not rot so quickly as the bigger stalks, and consequently will not scutch out.

The question of proper sowing seed, whether to produce fibre or more seed, is one of the utmost importance to the farmer, and he should have the germinating power of the seed he proposes to sow tested before he uses it.

CHAPTER IV.

SOWING THE SEED.

In Ireland, and probably also in Scotland, the best time for sowing is from April 20 to May 10; but a few days earlier in sheltered situations. Clover and grass seed may be sown with it. The earlier sown crops are the best if the season is a favourable one. It is true there are greater risks with early sown flax, but if successful the result is a much more valuable and heavier crop with a longer fibre than the late sown, though not so fine in quality. Late sowing is the surer plan and is also adopted when fine fibre is required. Since it is for aeroplane linen that the fibre is now urgently required, Scotch farmers might therefore follow the safer plan and sow fairly late.

In Ireland, where flax is grown for its fibre, the quantity of seed sown per statute acre is generally 1¾ bushels of Dutch seed or 2 to 2½ bushels of Riga seed. In France they sow nearly 3 bushels of seed per English acre, for in the opinion of French flax growers any less is very false economy.

In Ireland the seed is sown broadcast by hand. In England it is often done by a horse machine, drills being made for the introduction of the seeds, which are embedded about half an inch below the surface. On the Continent, and especially in Belgium and Holland, sowing is performed by a small portable distributing apparatus, sometimes termed a "fiddle."

In harrowing in the seed, a very light short-toothed seed harrow should be used and drawn to and fro. Having gone over the field in this manner it should all be gone over anglewise, as that will spread the seed more equally and the small drills that are made by the teeth of the harrow in the first instance will be obliterated.

When a sufficient quantity of seed is sown the plants are thrown up close, delicate and lengthy, with but one linter on top, until nearly three feet high, just as young fir trees grow when thickly planted. Sown in this way a fine and valuable quality of fibre is produced, at least one-fourth heavier than thin sowing would produce.

On the Continent flax seed is always sown broadcast, never drilled. For sowing perfectly calm weather should be chosen, but if there is a slight breeze the sower should always work with the wind at his side, blowing alternately on his left hand and on his right as he paces up and down the field and not at his back or in his face.

A fine, clean, compact seed bed is what is most necessary so as to allow of the seed being covered to a uniform depth, permitting a uniformly rapid germination, which is most important. Compactness is an important feature of the ideal seed bed, as it allows of the ascent of water from the lower strata to the somewhat shallow root system of the crop. The soil should be worked deeply and then consolidated, especially in the drier localities, in order that it may maintain all through the growing period a sufficiency of moisture, and so allow of full development of the seed. On no account must the seed bed be loose and friable.

When flax is grown principally for the seed it is sown thinly, when it has room to throw out a large number of branches in bush form. This renders the fibre coarse, but gives a large yield of seed. Branching spoils the quality of the flax for spinning purposes. It has been recommended to sow ashes over the sprouting seeds in order to put a stop to the ravages of slugs and grubs. A top dressing of soot would have an equally beneficial effect.

Weeding.

When a "braird" appears and is a few inches long the field should be carefully weeded, as the value of the fibre will be much reduced if it be afterwards found that weeds are mixed with it. In weeding, every precaution must be taken not to crush the young plants. When feasible, and especially in dry weather, it is advantageous to cut the weeds in order to prevent the loosening of the flax plants. In weeding the weeders kneel upon straw mats and face the wind, so that as they pass the breeze may assist the young stems to regain their upright position. Rough weeds, such as docks and thistles, are easily pulled. The most difficult to get rid of and the most injurious are redshank, charlock, and spurrey. These sometimes grow so plentifully that it is almost impossible to pull them by hand. At the usual weeding time redshank has not made much growth, but it makes greater progress after flax has attained its length. If it cannot be got rid of at or before sowing time, there is practically no alternative but to let it grow, which it will not fail to do, often to the great injury of the crop. Charlock is very easily and effectively destroyed by spraying with a 3 per cent. solution of sulphate of copper when the flax is from 3 to 6 inches long and before the weed plant comes into flower. This treatment has been proved to be most effectual and does not injure the flax in the slightest degree, with the exception of the damage which may be caused by pressure from the horses' feet and the wheels of the spraying machine. No one should hesitate to apply this solution where charlock is plentiful. As for spurrey, the best preventative is dry labour.

When large quantities of scutch grass are present with the flax a flock of sheep have sometimes been turned on to the field without any apparent injury being done to the crop, as sheep will not eat flax under any circumstances. However, this method is rather risky, and not to be recommended except in exceptional cases. In about four months' time the plant is ready for pulling.

CHAPTER V.

HARVESTING THE FLAX CROP.

Towards the middle or end of August, the plant should be ready for harvest.

In Ireland and on the Continent, where the best spinning flax is produced, the stems are pulled up by the root by hand. This is of course a tedious and laborious process, and will, it is hoped, soon be able to be accomplished by a satisfactory machine. While the quantity of fibre contained in the roots is very small, the cutting of the stems like corn leaves a square blunt end on the fibre which reduces its spinning qualities. The best fibre is obtained if the flax is pulled before it has quite reached maturity, or at the moment when the stems begin to get yellow at the base and the seed bolls become firm. The average flax grower knows well the proper stage at which to pull the crop. It is about the time when the stalk is cleared of leaves half way up. A more reliable guide is to cut a few average bolls straight across and squeeze out the seed. If sap oozes out it is still too green, but if the sap has all been absorbed in the seed, the crop is ready for pulling.

Pull the flax when the fibre is in the best state for spinning and still take off the seed bolls, which under ordinary circumstances will amply repay the outlay. Flax seed, even if not quite matured, when pulled ripens sufficiently afterwards, provided it is not detached until dry from the parent stem, all the sap which this contains contributing towards further nourishment and perfecting the seed. The Dutch avail themselves of this fact, and after pulling the stems they stack them. The seed by this means becomes ripe, while the fibre is harvested at the most favourable period of its growth. They thus obtain both seed and fibre.

In Belgium, where the fine quality of the fibre is the first object in view, the seed is only a secondary consideration and the manner of saving it generally is less calculated to produce a good quality of sowing seed. In the first place the flax intended for Courtrai steeping is pulled much earlier than by the Dutch farmers and the seed is often not fully matured.

It has been stated that in normal times the difference in value in favour of flax when pulled green and when allowed to ripen is £4 per acre. Thus the produce of an acre, if pulled green, might realize £20, which when allowed to become ripe would be worth only £16, but the green bolls are only worth £3 per acre, while the ripe might amount to four barrels and be worth £2 each, equal to £8 per acre, thus leaving a balance of £1 in favour of the ripened flax.

However, at the present moment, when quality and yield of fibre is of paramount importance, farmers should pull the crop when rather on the green side and about the stage already indicated.

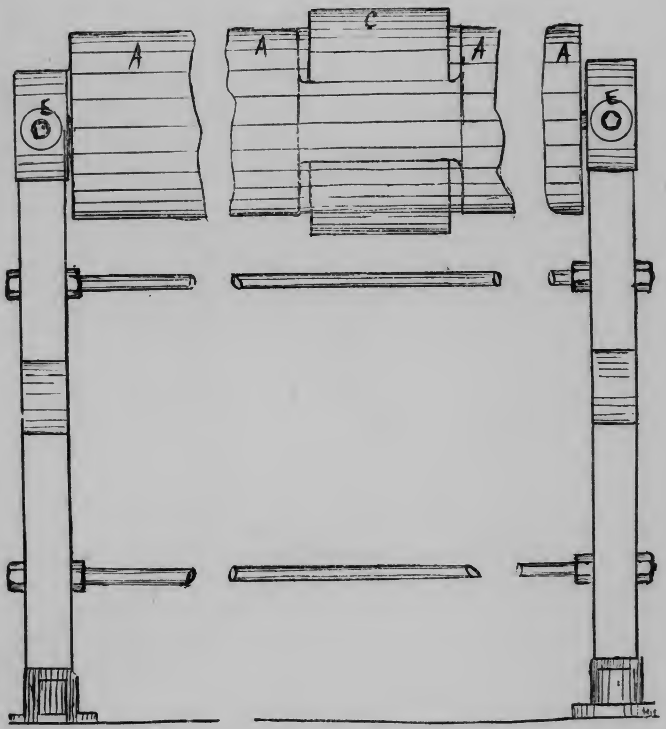
As the cultivation and harvesting, &c., of flax straw is a regular industry in Belgium, we will give a description of the method there employed as representing the best practice, at the same time noting the different modes of procedure in vogue elsewhere. The Flemish pullers pull the flax straw up in handfuls about one half larger than they can grasp in one hand. Extra care in pulling is well repaid, as when flax is pulled neat and square it can be easily kept so in the after processes. In pulling, the long and short stems should be kept separate as far as possible. Ordinary green flax as pulled weighs 5 tons per acre. This is reduced about 55 per cent. by sun and air drying, leaving 2 to 2½ tons of dry straw per acre. From the latter amount seeding or rippling takes away about 20 per cent. or nearly 10 cwt., leaving 32 to 40 cwt. When pulled the Flemings spread out the straw a little as they lay the handfuls on the ground in rows, the bundles with the tops and roots alternating, which prevents the seed bolls from sticking to each other in lifting.

In Ireland and in the "blue" districts of Belgium on the contrary, where the flax is either rippled green or steeped with the seed on, the pulled flax is tied up by rush bands, or with bands taken from the crop itself, into beets (sheaves) of about 15 in. in circumference which are either carried to the "ripple" or to the steeping dam. For Courtrai steeping, however, the straw is stooked as soon after pulling as possible and never allowed to remain over-night unstooked, except in settled weather. The stooking goes on at the same time as pulling, as if rain comes on while on the ground the colour of the fibre is injured. A good stooker can put up the produce of an English acre per day with two girls or boys to hand him the bunches. The flax straw is handed with the tops to the stooker. The handfuls are set up resting against each other, the root ends will spread out and the tops joined like the letter A. The stooks are made 8 or 10 feet long and are very narrow at the top, and the straw is thinly put up so that it may dry.

In Ireland, if the weather is dull and dark, flax for green steeping will not be injured by being left in the stooks for a few days after it is pulled; on the contrary, this may improve it, but if sunny weather prevails the sooner it is put into the retting pond the better, as the sun will have the effect of making brown "scruffy" stripes in scutched flax which is difficult to scutch and reduces the quality of the bulk.

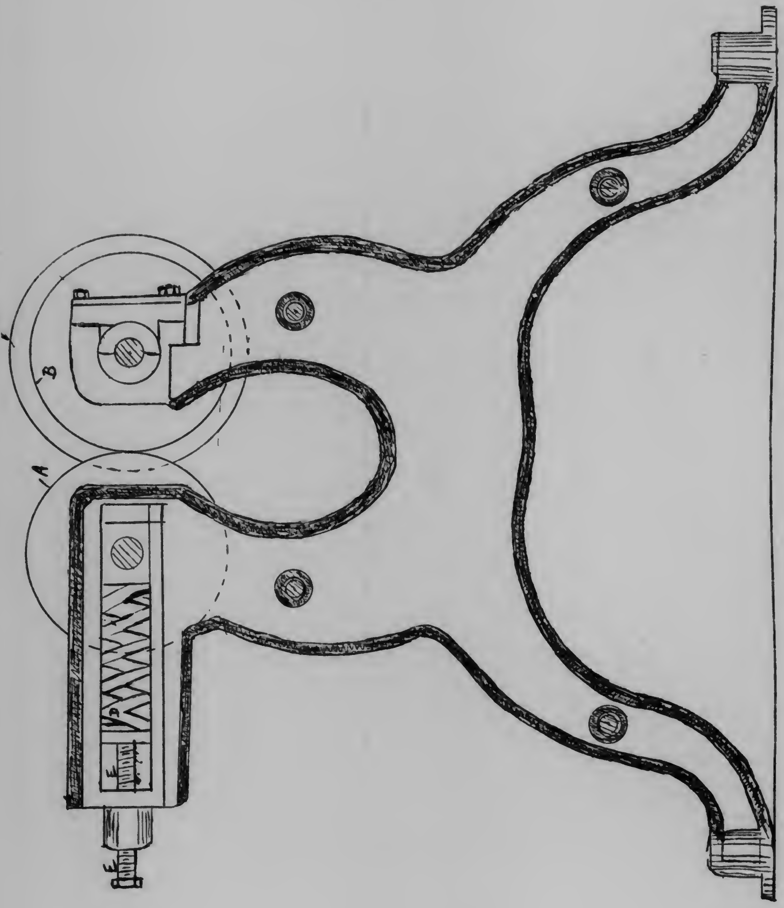
Under the Courtrai system, after a few days' winnowing in the stook, the straw is ready for tying into sheaves, like corn sheaves. It is then built into long rows or ricks, with the ends of the flax containing the seed exposed to the weather for perhaps a month, the long rows of straw, perhaps 5 ft. high and one sheaf deep, being covered with straw on top to keep off the rain until the seed is dry enough for stacking. In building a stack, two poles are laid parallel on the ground about 12 in. apart, with strong upright poles at each end.

The straw is then built in, the length of the sheaf in thickness or breadth. The bottom poles are laid north and south, so that the sun gets at both sides of the rick during the day. In building, the sheaves are laid tops and roots alternately, built 7 or 8 ft. high and finished on the top by laying a single row of sheaves lengthwise across the others and then another row as before, but with the tops all the same way, which gives a slope to throw off the rain. The stack is then finished by putting a little straw on the top and tying it down with a rope. In this way, if properly built, it stands secure for months or years without injury.



Flax Straw Deseeding Machine.

Face p. 16



Flax Straw Deseeding Machine.

CHAPTER VI.

SAVING FLAX SEED.

Under the Courtrai system the seed is taken off the dried straw during the winter after it has matured in the stook and rick. To remove the seed, the sheaves are loosened and the straw spread flat upon the ground, the top ends being struck with a sort of long-handled wooden mallet which knocks off the bolls. The straw is then bound up again as before and restacked or stored under cover until the spring when it may be steeped or retted, &c.

Dutch farmers who save seed, intending it for sowing purposes, winnow the straw in the stook in the field until it is dry enough to stack, the seed bolls being then rippled off and the seed preserved in the boll till it is cleaned for the market and by that means kept perfectly dry and in good condition for sowing purposes. Dutch farmers always save the seed of the flax and value it as high as £8 or £9 per acre. They say that this is done without any injury whatever to the quality of the fibre. From 29 to 32 bushels of flax seed per acre have been produced in Norfolk.

Flax seed if not quite mature when pulled ripens sufficiently afterwards provided the bolls are not detached until dry from the parent plant, all the sap which this contains contributing further nourishment and perfecting the seed. The Dutch avail themselves of this fact and after pulling the stems they stack them. The seeds by this means becomes ripe while the fibre is harvested at the most favourable period of its growth. They thus obtain both seed and fibre.

Great importance is attached to the operation of gaiting flax straw in Belgium and Holland. As the flax is allowed to stand in the stook (standing straight up) in the field to mature, completely ripen or season, the sun completes the ripening by drawing up the juices, oil or sap of the unripened part of the seed. This operation of the sun is watched very carefully, and it is made sure that maturity has been completed before the flax is hauled off the field and stacked in barns or sheds with the seed on, where during the winter months it is deseeded and then put into bundles or beets from 8 to 12 in. in diameter, and again stacked ready for steeping. The weight of the seed runs from 6 to 12 per cent. of the total weight of the straw. This of course depends upon the season as does also the total yield of flax.

When it is intended to ripple flax it is pulled in the ordinary way and held straight and evenly into beets. The rippling is done as follows: A rippling comb is attached to the end of a moderately broad plank, which is supported upon some convenient rest, such as a low barrel. The operator sits astride the plank facing the comb and splitting up the beets into small handfuls, strikes the seed over the comb, and draws them through the teeth towards him. This will remove the seed, after which the flax may be retied and put in the retting pond at once, care being taken to keep the butts of the beets as even as possible.

The ripple is a coarse comb composed of square section iron spikes set in a wooden stock.

When the soft green seed bolls are rippled off, they must be thoroughly dried. The best way to do this, when the weather permits, is to do so either outside on sheets or indoors in airy lofts, over the floors of which they must be thinly spread; but for feeding purposes, if the weather is indifferent, they may be gently dried on the nearest corn kiln. Air drying is, however, the best system and leaves the rich juices of the seed more valuable and nourishing. When sufficiently dry, the bolls destined for crushing or for sowing must be thrashed to separate the seed from the husks, but this is not necessary when they are to be used for feeding.

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ENGLAND.

Flax seed rippled off green flax straw makes a useful feeding stuff and will keep if spread a few inches deep on a dry wooden floor in an airy loft and frequently turned to prevent heating.

When grown for seed only, the flax straw is thrashed by machine as is oats.

For instance: When fibre is to be extracted from the straw, the greatest care must be taken to preserve the stems with root or butt ends even and to prevent them from being tossed and broken as they would be in a thrashing machine.

The method of deseeding flax fibre straw most suitable for large growers, and that used in Yorkshire, Dorset and Somerset, is by means of the machine here described.

This machine consists of a heavy iron framework carrying a pair of rollers, one of which is power-driven by a belt running over the pulley in the centre, the two ends being thus available for use. The other roller is pressed against the former by spring pressure, which may be regulated by means of the adjusting screw. A man works at either end of the machine, and taking a handful of straw spreads the crop end out fanways and passes it between the rollers without letting go the root end. He passes it through several times after rearranging the position of the stems until the bolls have been squeezed off the branches.

Two men may, with the necessary attendance, deseed the product of three acres per day.

A machine, the invention of M. Legrand, does the work of about thirty men in the Belgian style at about one half the cost, say at 2d. per cwt. of deseeded straw. In this machine the straw is struck by mallets or beetles with fluted faces, falling upon a resilient surface, so that the machine is not choked if heavily fed. The straw is fed in handfuls upon an endless feed sheet and held by two bands across the root end so that the stems cannot slip while the top end is under treatment between the two deseeding planes.

Vibrating sieves clean the seed thus knocked out and deposit it and the boll chaff in separate bags. Twenty tons of straw may thus be deseeded per day at a cost of about 2s. 6d. per ton.

A comparatively small part of the world's production of flax seed is used for sowing purposes. The bulk, either grown for its own sake, or removed from flax straw when the fibre is to be extracted, is crushed to extract that valuable product, linseed oil, the refuse being sold as "cake" to feed cattle and provide a rich and fattening diet. Huge areas in America, Southern Russia, India and elsewhere are sown with flax for seed alone, the straw being burned to get rid of it.

For use for cattle feeding purposes, the seed given by itself is too strong and oily to be very wholesome as food: and besides this the hard shiny skin prevents the seed from being bruised by the animals' teeth or dissolved by the gastric juices of the stomach. It is much better to take the bolls to a mill, where there are edge stones, without thrashing out the seed, and to have them ground under the stones set very close, or have the seed cracked in an oat bruiser. The chaff and seed mixed together afford most excellent nourishing feeding. It may be given steamed or boiled, but it is best to steep the mixture from twelve to twenty-four hours in cold water and then mix it up with lukewarm water to the consistency of gruel. It will have formed a rich finely dissolved jelly, easily digested and of the most wholesome and nutritive quality, excellent to be given to cows for producing plenty of milk and butter, for horses, for young cattle or for pigs.

A pint of linseed and half a bushel of chaff may be given at a feed. A farmer who has once experienced the advantages of the saving of the seed bolls of his flax crop will never neglect it again, as they can be turned to much advantage in one way and another.

Linseed oil is pressed from the seeds by hydraulic pressure. It is sometimes cold drawn, but it is usually expressed after the seeds have been subjected to a heat of 200° F. The yield of oil from flax seed varies from $10\frac{3}{4}$ lb. to 16 lb. per bushel of seed. Irish seed seldom yields more than 11 lb. while East Indian seed yields the most.

CHAPTER VII.

RETTING.

The retting of flax straw, either in the green or dried state, is undertaken with the object of rendering soluble the gummy matter which binds the fibre around the stem so that separation may be effected with the minimum breakage and loss of fibre. Mechanical decortication without retting has never proved a success, as the fibre produced remains coated with an insoluble gum which does not macerate in the hot water trough of the wet spinning frame and prevents the fibres being drawn apart.

Soft water is the best for flax retting and all waters having strong mineral qualities should be avoided. The action of the salts of iron upon the modification of tannic acid in the flax straw is very prejudicial.

It is known that—other conditions being equal—the speed of fermentation or retting increases with the rottenness of the water. It also increases with the temperature.

It has been established by biological study of the retting process that retting is primarily a process of fermentation brought about by the action of microbes developed in the straw itself.

The nature of the water and ponds for flax steeping has various peculiarities and characteristics with which it is necessary for the grower to be thoroughly acquainted. Soft water and a blue clay subsoil in ponds will invariably produce a clear "blue" colour and a superior quality of fibre. Hard spring water in ponds with a gravelly or sandy subsoil will generally produce fibre of a light colour and inferior quality. In many districts, no other ponds are available and these have to be used. When this is so, the best thing to do is to fill the dams early, say in the month of May, and allow them to remain so until required. There should always be a considerable quantity of mud left in such dams and they should never be entirely cleaned out. By following this treatment it will be found that even these inferior dams will give fairly satisfactory results. The water should always be stagnant, unless there is a very large body of flax confined in a small space, when a very small run of fresh water may prove beneficial.

Newly made dams often fail to ret satisfactorily for the first year. When such are used, it is advisable to put in a few loads of mud from some previously used dam to supply the necessary bacteria.

In Ireland and in some parts of the Continent flax is steeped or retted in earthen dams or ponds of any convenient length and about 9 ft. wide and 4 ft. deep. The bundles of flax straw are packed in almost vertically with the top or crop end up. Mud or sods are then placed on top and the whole kept down by stones, so that the butts are covered by about 3 in. of water. As fermentation proceeds, the beets tend to rise and more stones must be put on to keep them down. There should always be a sufficient depth of water in the retting pond to float the flax and the beets should never be packed so tightly as to prevent free circulation of the water, nor should the flax be weighted down so heavily that it will not rise in the pond when fermentation begins. The less weight upon it the better so long as it is kept under water. The practice of placing two rows deep in ponds is not to be recommended, as it will be found that one row will be considerably more retted than the other, and if both are mixed together the flax will not scutch satisfactorily and the yield and quality will probably be reduced. Where it is necessary, owing to scarcity of convenient ponds, to put in two rows, it is advisable to keep each row separate and have them scutched so.

In the Bruges and Lokeren districts of Belgium the beets of flax straw are put into the pond perfectly flat to the depth of about five rows, or as much as the water will cover. The water is usually collected from percolation after rain, and as the ponds are nearly full before steeping begins the worker stands in the water and builds the beets of flax straw in, row after row, to the requisite depth across the pond. In the Bruges district, when the pond is filled, the surface of the top layer of flax straw is covered with oat or wheat straw to keep off the sunlight, and on this again a quantity of sods are placed to press the flax evenly under water, much after the Irish method of stoning. In the Lokeren and other "blue" districts of Belgium, as well as in Holland, the mud which accumulates at the bottom of the pond year after year is employed to cover the top layer of flax. The worker engaged in putting the flax into the dams uses a spoon-shaped wooden shovel; with this he, in the first instance, throws a quantity of water over the top layer of each section as it is put in, until it is thoroughly saturated. He next gets a heap of mud scraped from the bottom of the pond and usually collected at intervals along the sides of the dam, and shovels it over each top layer of flax straw, effectually covering it with a layer from 4 to 6 in. thick. Each layer as put in is treated in the same way, so that when the filling of the dam is completed the top surface presents a level expanse of soft black mud. The main purposes served by this mud covering are: (1) To keep off light, and thus prevent discoloration; (2) to give the fibre the requisite blue or black colour; (3) to make the retting process take place more uniformly throughout the entire mass; and (4) to serve in lieu of stones to keep the flax straw under water. Though the upper surface of mud is quite compact and continuous, that which adheres to the top of each beet is easily removed by giving the latter one or two plunges in the water before it is taken out. When sufficiently long in the steep, the flax is not thrown out by hand, as in this country, but is lifted out by means of a fork. The worker standing at the side of the dam detaches each beet from the heap, and after plunging it down once or twice in the water to remove the mud, places the fork underneath it and deftly lifts it out on to the bank.

It is worthy of remark that in these "blue" districts, the water in the ponds is entirely stagnant during the time the flax is being retted and no further water is allowed into the pond after the flax has been put in.

The farmers in the Lokeren district are of the opinion that the best results are obtained when the flax is pulled green and steeped immediately after rippling, as is the usual Irish custom.

In the Dortrecht district of Holland, the beets are placed in narrow dams in a sloping position and not more than two layers deep, the boll or top end of the flax being downwards —which is the reverse of the method adopted in the "blue" districts—and covered with mud.

In some Flemish retting dams sticks are placed along the sides of the dam to keep the flax from contact with the earth. Upon the top of the flax they lay a straw mat and upon this sticks and planks loaded with stones to keep the flax down.

Flax retting proceeds quite successfully in a running stream of fresh water or in a fresh-water lake. The best flax produced is retted in the River Lys in Belgium, while its substitute "white Dutch" is retted in the River Scheldt in Holland.

The effect of running water is to produce flax of a light yellow colour. This always fetches a higher price in the market. The same effect is produced in large ponds or lakes of fresh water.

In some parts of Ireland, notably on the upper Bann River, flax straw used to be tied up in large bundles attached to a stake by ropes and thrown into the running stream.

It is evident, therefore, that the process of fermentation must go on in the juices and gummy matter which connect the fibre to the woody stem, as the water itself has not time to become decomposed in passing through the bundle.

On the River Lys, where as we have said the finest flax procurable is produced, the flax is either steeped in September of the year it is grown, or in June the year after. The commoner qualities are steeped the same year and the better qualities held over.

The colour of flax generally is improved by a small stream of water continually passing through the ponds during the steeping, which water, even from a stream of comparative softness, should be exposed to the atmosphere in a pond for at least a week, before being used, but if from a spring of hard water a much longer time of exposure to the atmosphere is necessary.

The retting of flax straw is a regular industry around the town of Courtrai in Belgium, where flax is retted in the River Lys. The success achieved on the Lys is probably due in a great measure to the slow movement of the water and the exceptional bacterial development resulting from continuous retting. Under the Courtrai system the seed is taken off the dried flax straw during the winter, when two sheaves are tied together with three bands of rye straw (one near each end and one in the middle) and are so arranged that the root ends of the sheaves are at opposite ends of the bundle. These bundles, about 12 in. in diameter, are then restacked or kept under cover until the spring, when they are sometimes retted. It is generally considered better, however, that the flax straw be kept for at least a year before steeping, and it is sometimes even kept for two years, a practice believed to increase the strength of the fibre. Much nicety is required in preparing the flax straw for steeping if the very best results as regards light colour and quality are desired. To obtain such results the sheaves should be untied and the flax shaken over, a few stalks at a time, in order to remove all dust, leaves and weeds.

For steeping the parallel bundles, made as described, are packed either horizontally or vertically in large wooden crates or "ballons," about 10 ft. by 8 ft. by 3 ft. deep, lined with straw and sacking. The upright position is usually adopted, as it is said to be more favourable to the production of light coloured fibre, as no sediment or deposit can rest upon it at any stage of fermentation. Straw and boards are afterwards placed on top and the crate thus lined slid into the river, anchored in the stream, and weighted with stones, so that it is submerged a few inches below the surface. In a few days fermentation begins and as it proceeds additional stones are added from time to time in order to prevent the rising of the crates through the evolution of gas. As a rule, after steeping for a few days, the flax is removed from the crates and set up in hollow sheaves to dry, the advantage of the interruption of the retting process at this stage being that exposure to the sun and air kills the microbes of putrefaction which have developed, so that the strength of the fibre remains unimpaired. When dry, or later, it is repacked in the crates and again steeped until retting is complete, in seven to twelve days, according to the temperature and quality of flax. When repacking the flax straw in the crates for second retting, care is taken to arrange the bundles so that the end at the bottom during the first retting is placed at the top in the second retting. The second retting does not take so long as the first retting, the exact period depending upon the extent of the first retting, quality of the straw, temperature, &c.

The total duration of steeping is about, say, six days in August, ten in May, and twelve in October, but occasionally as much as twenty-eight days when the temperature of the water is much lower. When the temperature of the water is high, retting proceeds much more rapidly than in colder weather. Fine thin stems require a longer time to ret than do stouter stems. The average time taken for retting in the North of Ireland, with water at 64° F., is about nine nights. In all cases Continental retters ret until the straw is considerably softer than is usual in Ireland.

The end of the process is accurately determined by occasionally examining the appearance of the stems and applying certain tests. The bundles of straw should feel soft and the stems be covered with a greenish slime, easily removed by passing them between the finger and thumb. When bent over the forefinger, the central woody portion should spring up readily from its fibrous envelope. If a portion of the fibre is separated from the stem and suddenly stretched it should draw asunder with a soft and not a sharp sound. A common test is to break a few average stalks at points from four to six inches apart, and if the woody part between pulls out clean and easy from the fibre, it is then about the proper stage for taking out of steep. The stems tested should be drawn from various parts of the retting pond.

It is said, on the authority of a Dutch Boer, that in steeping flax, when the bubbles of air disappear from the surface of the water and the flax seems to have settled to the bottom, it may then be concluded that the operation is nearly finished.

It is known that, other conditions being equal, the speed of fermentation increases with the rottenness of the water. Thus, in the Lys, retting proceeds much quicker and better the more flax is being steeped for the first time (in the second retting, fermentation being practically *nil*).

Flax should be taken out of the steep carefully, the use of forks being avoided where possible, as they are certain to injure the soft retted straw. The flax fibre is injured if the stems, as they are taken from the steeping dam or river while the gum is in a wet state, are handled or exposed to rain, for the removal of the gummy matter in spots leaves those places weaker.

On the Lys, when retting is complete, the crates or ballons are pulled ashore and the flax straw carefully removed and placed in an upright position on a light layer of straw, where it is allowed to drip and drain for about twenty-four hours. When all is removed from the crates, it is lightly covered with straw or sacking.

When a considerable quantity of water has thus been got rid of the flax is wheeled to the drying ground, where it is set

up in sheaves to dry, this time in the shape of a hollow cone, or is "gaited" in close rows which are regularly turned.

Dam-retted flax, when sufficiently long in the steep, is in Ireland thrown out on the bank by hand, but is on the Continent forked out. It should not, if possible, be allowed to remain there for more than twenty-four hours. If the weather is very warm it may heat, and the fibre be considerably weakened. It is consequently taken and spread on the grass, where it is allowed to lie, in some instances, as long as six weeks. It should be spread rather thinly and well shaken. If thrown down in unshaken lumps the colour of the fibre will not be uniform but will be more or less striped.

On the Continent it is spread thicker than is the case with us. Very thin spreading is likely to become tossed and straggle very considerably, and will give no better result than thick spreading when well shaken. While on the grass the flax straw must be frequently turned, after every shower if possible. This operation may be performed by means of a long pole, the pole being pushed under the row of flax and a length of about 12 ft. being turned at each thrust. If weather conditions are favourable, spreading gives a more uniform colour than gaiting. However, if the weather is very showery, gaited flax will suffer less injury from the rain than that which is spread. Gaiting is quite as easy if the seed has been rippled off, as it is hoped in the future it always will be before retting. Besides improving the colour grassing causes the fibre to contract and to leave the boon and render scutching much more easily accomplished.

The best Courtrai flax is sun-bleached after retting. Clean pasture land is rented and the flax straw spread about ¼ in. thick in straight lines, root ends even as a brush, having a distance of about 4 in. between each line. In dry weather it remains twelve to fourteen days on the grass; in wet and warm weather about four to five days. In dry weather it is turned every three days and in wet weather every day, the object being to obtain a bright yellow colour. In very warm weather, a few hours too long on the grass may entirely spoil its colour. The moment therefore a few blue spots make their appearance on the fibre it is quite time to lift it from the grass and set it up in hollow cones to dry, as when it comes from the steep, but in dry weather it may be taken from the grass and tied up at once. In this case, however, it should be turned on the morning of the day on which it is to be lifted.

Flax intended for summer bleaching should be steeped a little more than that intended for March bleaching, because in summer it cannot remain long enough on the grass to soften without spoiling the colour, while in March it can remain on the grass sometimes seven or eight weeks without injury to the colour, and during that time flax steeped too little will become properly soft for scutching.

When sufficiently grassed and dry the flax straw is lifted and tied up in fairly large beets. If heavy rains are prevalent, it is advisable to lift the flax even when half dry, tie it rather slack in small beets and put it up in stooks or "gaits," in which it will soon dry satisfactorily. Heavy rains at any stage while the crop is spread are very injurious, but especially so when freshly put down, and it is safer, five times out of six, to lift the flax as soon as it is in proper condition. If the weather is favourable and there are dews at night, a few days on spread under such conditions may effect an improvement. After being a few days in stooks, the flax should be stacked for at least two weeks, preferably a month, before being taken to the scutch mill, and much better results will follow than if it was scutched direct off the spread field.

It often happens that when put in store at this stage, apparently perfectly dry, it will in a few days " come back " again and become so damp as to lead to considerable difficulty in the scutching, and consequently there will be more waste from the scutching handles. When the flax is scutched immediately after being taken off the spread field, most unsatisfactory results will be obtained. As a rule, the straw

at that time will have one of two faults, and occasionally both combined. If sunny weather prevails, it will likely be too hot and bristled—a condition which renders scutching easy but is detrimental to yield and quality; or it may be too dry on the outside of the beet and too damp on the inside, which condition will give even worse results. But when stacked for a few weeks the straw becomes of a uniform cool character, a condition which may be expected to give best results.

The dew-retting of flax is practised to a large extent in Russia, and combined with water retting in the Walloon district of Belgium and in Brittany. It is a most primitive method and consists in spreading the freshly pulled flax straw lightly over the field and allowing it to remain there until the combined action of the sun, rain and dew has accomplished the partial dissolution of the gummy matter which binds the fibre to the wood. Its only advantage is to save the disagreeable work of water-steeping, for which reason it is being advocated in certain quarters to-day. We do not recommend it, however, as against water-retting, to produce fine and strong spinning flax; besides in this country dews cannot be depended upon long enough to complete the operation, and there is a strong possibility of a storm of wind scattering the flax, or rain causing it to lose half its value. It can only be advocated for the purpose of saving expense and labour. The yield of fibre is perhaps somewhat greater than that produced by the usual method, but the quality is not so good. Most dew-retted flax is, although coarse, of uniform colour and strong fibre. Russian dew-retted is fine, but soft and weak.

Flax straw intended to be dew-retted should first be dried and then crushed in the flax rollers. January and February dew-retting gives the best coloured fibre and is called in Belgium " March flax." In France before grassing for dew-retting, the straw is sometimes wetted with a weak alkaline solution. In Holland it is sometimes watered with salt water or steeped for some time in a saline solution.

Ordinarily green flax as pulled weighs 5 tons or 11,200 lb. per acre. Drying takes away about 55 per cent., or 6,200 lb., leaving 5,000 lb. From the latter amount deseeding or rippling takes away about 20 per cent., or 1,000 lb., leaving 4,000 lb. Retting or steeping still further reduces the quantity about 20 per cent., or 800 lb., leaving 3,200 lb. to be scutched.

Some authorities reckon that flax straw loses only about 16 per cent. in weight by two rettings in the Lys, and that in still water or dam-retting the loss in weight is not so great—say 14 per cent. These discrepancies are no doubt due to the degree of dryness of the straw or the amount of sap left in it. No artificial method of retting has proved so efficacious as that practised from the earliest times. Some of the castings on the Egyptian tombs show the retting dam being filled with water, the laying of the flax therein, and the removal of it afterwards for drying purposes. The water in which flax is steeped, retted, or watered should be saved for use as liquid manure on account of its fertilizing properties.

CHAPTER VIII.

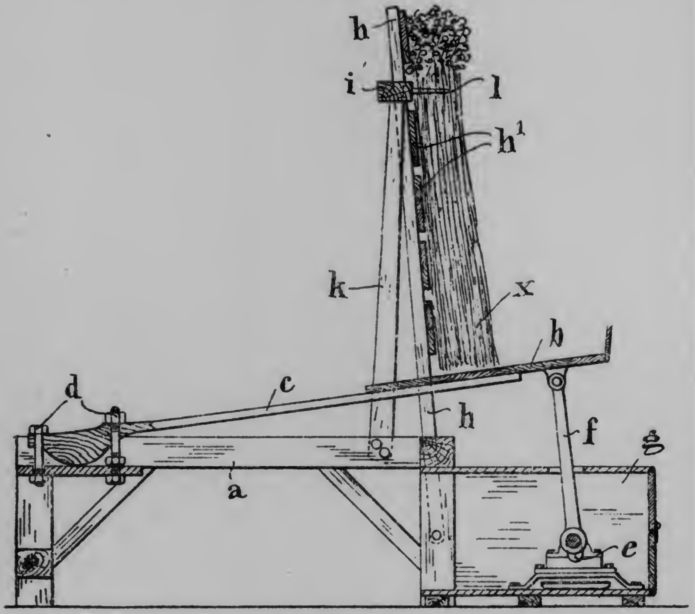
FLAX SCUTCHING.

THE word scutch is of doubtful origin, and is supposed to be another form of the word "scotch," when it is used to convey the meaning of separating by cutting, such as chopping off a piece of bark.

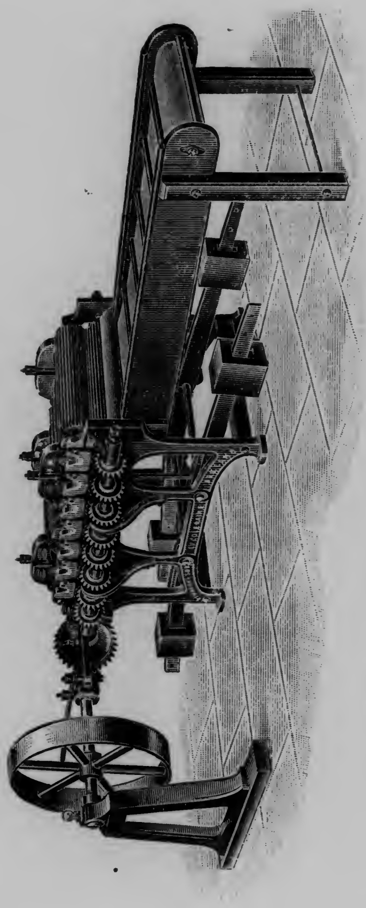
Modern scutch mill machinery consists first of all of a butting machine to equalize the root end of the striks; next, of a breaker or set of crushing rollers, a series of pairs of fluted rollers which crush the straw and break up the "boon" into small pieces, which if the flax has been skilfully retted are easily separated from the fibre by the strokes of the beater, a series of revolving blades called "handles."

As we have already emphasized, in order that the maximum yield may be obtained in scutching and hackling flax, it is advisable that in pulling, the long and short stems be kept separate as much as possible and the root end even. The evenness of the root end must furthermore be maintained through all the stages of preparing the fibre for spinning. To ensure the evenness of the root end of the striks of flax straw presented to the scutcher, the ingenious machine shown in section has been devised, and is being successfully used in several large scutch mills both at home and on the Continent. The machine comprises a slightly sloping table *b*, with a back *h*, against which the flax straw is placed root end down on the table and leaning against the back. A vibratory motion is given to the table by the crank *e* and the connecting rod *f*, which motion causes the individual stems to settle down by gravity, being prevented from falling sideways by a horizontal bar *i*, fixed to the back and having projecting spikes *l*, which enter the bundles of flax straw. The table is mounted on springs and the spiked bar is vibrated by a crank or eccentric and connecting rod *k*, at the rate of about 450 per minute, the throw being about ¾ in.

Although in some parts of Ireland there are still vertical sets of three-fluted rollers at work giving two "nips," also at least one set of flax beetles, horizontal sets of four to eight pairs of fluted rollers giving four to eight nips are now almost universally employed, and such a set is illustrated herewith. The crushing rollers are heavily weighted either by levers and weights or by spring or rubber buffer pressure. In the old vertical and new Williamson machines the flax straw is



Butting or root levelling machine for flax straw.



Modern horizontal set of flax straw crushing rollers.

guided into one nip, constrained by a guide to follow the centre roller or the end roller of a row, as the case may be, and passes out again to the attendant through the second or last nip respectively. The old vertical machine is 6 ft. high, and occupies floor space 7 ft. by 5 ft., weighs approximately 13 cwt., and costs in normal times about £21. Its production is sufficient for a four-stock mill. It requires about two horse-power to drive it. A four-pair set of rollers usually suffices for a four to six-stock mill, but for over six stocks a six or eight-pair set is generally used. A four-pair set occupies floor space 7 ft. by 9 ft. 6 in., weighs about 23 cwt., and costs approximately £28 in normal times and requires 2½ horse-power to drive it.

A six-pair set occupies floor space 7 ft. by 10 ft. 6 in., weighs about 31 cwt., costs £38 in normal times and requires three horse-power to drive it. An eight-pair set occupies floor space 7 ft. by 12 ft., weighs 40 cwt., and cost before the war £48. These machines are either belt driven with fast and loose pulleys or are driven direct from the wipe shaft by means of a clutch. They should be fitted with an automatic throw-off motion in case of accidents. The rollers are about 8 in. in diameter, and have from fourteen to twenty-four flutes, ½ in. to 1 in. deep.

Flax breaking or crushing rollers are always fluted. As it is absolutely necessary that the fibre be not injured, the flutes should not bottom and thus run "hard to hard." The bottom rollers are positively driven while the upper ones turn by contact with the lower set. The positive drive of the bottom rollers usually consists of a side shaft and clutch.

Occasionally in addition to the set of fluted crushing rollers there is a pair of plain or scratch-fluted delivery rollers and sometimes two such pairs, between which a pair of winged cleaning or scraping rollers may be run at a comparatively high rate of speed—say 250 revolutions per minute—to scrape off adhering woody matter or "shove," the rollers being so geared that the wings in one intersect between the wings of

the other. In order that these rollers may not lap, they are frequently perforated and hollow, and a stream of air is pumped through them. The crushing rollers make about twenty-eight revolutions per minute. Their surface speed is thus only about one-ninth that of the scraping rollers.

In such horizontal sets of rollers the fluting of the succeeding pairs of rollers becomes progressively finer, with the object of breaking the straw in a large number of places, or making the particles of woody matter to be knocked out smaller.

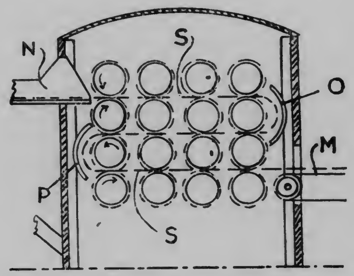


Diagram showing the principle of Williamson's Patent flax rollers.

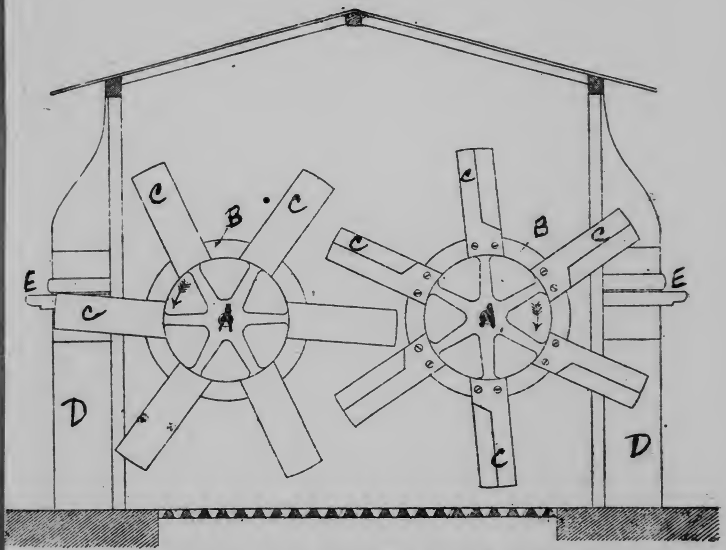
With the vertical 3-roller set of rollers this of course cannot be done, nor can it be with the latest form of horizontal set, which being little more than an enlargement of the 3-roller type gives twelve nips with four rows of four rollers, or sixteen rollers in all. The main advantage of this latter machine is a saving in floor space, as a machine to give twelve nips occupies no more space than a four-pair horizontal machine of the usual type, which gives only four nips. Furthermore the fact that the pitch of the flutes on the rollers is the same from one end to the other does not of necessity mean that at each nip the straw is caught and broken again at the same spot. The centre to centre distance of the rollers should be so calculated with relation to the pitch of the flutes that the straw is each time broken in a different place. We repeat, the more completely the straw is broken up without injuring the fibre, before being submitted to the operation of scutching proper, the greater the yield of long fibre and the better the quality of the product. Even the best scutchers cannot take the greatest possible yield of long fibre out of the flax straw unless the woody part is thoroughly crushed and broken by the rollers, so that the piece being scutched falls slack and supple over the scutching stock. If the straw is so prepared and the stocks and handles properly adjusted, the handles scutch right into the heart of the piece at first contact. If not sufficiently "rolled" the mill will hammer and waste the ends before the middle of the piece is broken, consequently when clean of shives, the fibre is reduced very much both in quantity and quality.

An end section of the central part of an Irish scutch mill is shown in the figure. AA are the horizontal shafts upon which the "rims" or "circles" B are keyed. CC are the scutching blades or wipers of wood, screwed or bolted to the rims. The stocks D consist of an upright board or iron plate, in a slot E in the side of which the flax is held by the scutcher, who stands on one side while the revolving blades C strike the flax in rapid succession on the other. Irish scutch mill handles are fewer in number and much heavier than those used in Belgium. They are more severe on the flax and make more tow, but until retting becomes a science, as it is on the Lys, they must be preserved. Six-point rims give very satisfactory results. There are two sets of handles—one for doing the rough work or cleaning, and the other for finishing or buffing. The buffing handles are bevelled on both sides of their face, while the cleaning handles are rounded off on the side away from the scutcher only.

The number of blades on the rim of the Belgian circles is ten or twelve. The rims are about 4 ft. in diameter and the blades ⅝ in. thick. They are of walnut wood, 27 in. long, projecting 10 to 12 in. beyond the rings or circles, 5½ in. wide, tapering to 4½ in. at the point. These blades are held in

position by two steel rings, which are riveted to an iron boss, keyed upon the driving shaft.

In Irish mills the diameter of the wiper rims varies from 3 to 4 ft. Three-feet rims are now generally considered too small, although the Department of Agriculture recommend them. Rims 3 ft. 6 in. in diameter are now more general. In normal times, including shafting, pedestals and cast iron stands, they work out at about £5 per stock. Continental rims are quoted at 16s. each; walnut blades at 4s. 6d. per set, and stocks 6s. each.



Section showing stocks and handles of an Irish scutch mill.

The hand-board or stock should be in line with the centre of the scutching shaft and the back of the handles 4 or 5 in. above the hand boards.

Turning now to the working of a flax scutch mill. Nothing is of more importance in obtaining maximum yield of long fibre from the flax straw than careful streaking or "stricking" and especially in keeping the butt or root end level, i.e., long or short stems if such are present, or all stems, on the same level as they grew in the field. This squaring of the root end may be done either by hand or by the "butting" machine already described. If done by hand, the handfuls or beets of uncrushed straw must be "chopped" or knocked on the ground and the root end squared as well as possible in this way, protruding stems being pushed upwards and receding stems given a chance of dropping down to the same level. The butting machine, already referred to, does this work, and in a very superior manner, and furthermore straightens out the straw or parallelizes the stems so that the bulk is much more easily separated into handfuls by the feeder of the crushing rollers without producing loose and displaced stems. When the straw has not been prepared in this way the streaker, who separates the beets into handfuls for the rollers, finds some difficulty in separating these handfuls, the stems not being perfectly parallel. Loose and straggling stems are consequently produced, which being displaced are often lost in the tow and go to diminish the yield of long flax. To minimize this, streakers ought to pull out these loose stems by hand and replace them in the proper position.

If properly streaked the crushed straw or fibre comes out of the rollers perfectly square. The attendant gives the handful a twist and builds the pieces into a bunch for the scutcher.

An up-to-date set of rollers is an absolute necessity if best results are to be obtained both in quality and quantity of fibre. If the straw has been properly crushed and in fairly small pieces, the scutcher requires no more than the average strength and muscle to hold the piece against the stroke of the blades and prevent the fibres slipping and the piece getting out of shape.

In spite of care, however, it must be emphasized that the best scutchers in the world cannot repair the damage done by bad pulling, unskilful retting, careless spreading, drying and gathering.

We repeat that rolling is one of the most important operations of the scutch mill. The flax must be kept and given to the rollers in good shape, butt end square and even, if the best results are to be obtained. If not sufficiently rolled, the scutching blades hammer and waste the ends before the middle of the piece is broken. Consequently when clean of "shows" or "shive" in the centre, the fibre is reduced very materially both in quantity and quality. This matter can be easily tested in a very practical way. Take two beets of the same quality out of the same lot. Put one through the rollers and scutch it. Then scutch the other without any rolling. Note the results both in quantity and quality of fibre. A somewhat similar result will be obtained by testing an up-to-date set of flax rollers against an inferior and worn-out set.

Flax should not be scutched immediately after grassing, for the straw is then hasky and fresh, and much of the fibre will be carried away by the handles and the yield much deteriorated both in quantity and quality. By keeping the straw in stack at least a month before scutching, the fibre is much improved both in strength and spinning quality. It is also improved by merely buffing it at the first operation and holding it over for twelve or fifteen days before finishing it.

In scutching, the scutcher takes the handfuls of crushed or rolled straw from the bunch made up from the rollers and holds them one at a time in the notch E of the upright stock. First the root end is operated upon by the revolving beaters C, and then the piece is turned and the top end scutched, the piece being opened out and exposed to the action of the hurdles by the fingers of the right hand while firmly held by the left. When the scutcher has thoroughly cleaned his piece or strick, he pulls out loose fibres from the ends, gives the piece a turn to keep it together, and builds it with others into a bundle of given weight, usually a stone of 14 lb., which is bound with flax bands ready for the market. Courtrai and Hasnon flax is made up into bottes, of which seventy-two go to make up a 2-cwt. bale. Bruges flax is put up into Flemish stones, of which there are twenty-seven in a 2-cwt. bale. Unfortunately the weight of a Flemish stone is not at all regular, for 33½ Waereghem stones, 34 Ghent, Wetteren or Welle stones, 36 St. Nicholas, Malines, and Lokeren stones are required to make up a 2-cwt. bale. Dutch flax is put up into stones of which thirty-six make up a 2-cwt. bale.

In the flax scutch mills around Courtrai, the ends of the cleaned strick are combed out on a little hackle, and the loose fibres pulled out by means of a touch pin. The strick is furthermore so handled and rubbed up that it presents a very sightly appearance. There being twelve point rims in a Flemish mill or twelve blades to the round, the effective diameter of the circle being 4 ft. 6 in., and the shaft making 175 revolutions per minute, about 2,100 strokes are given per minute by the blades, the speed of which is nearly 2,500 ft. per minute. In Ireland, although the shaft runs faster, a fewer number of heavier strokes are given as there are only approximately half the number of blades to the round.

The yield of scutched flax is approximately 22 per cent. of the weight of the dried and retted straw, although only about 4 per cent. of the weight of the green stems, or 9 per cent. of the weight of the same, are dried.

The relative average yield of scutched flax and tow produced in an Irish scutch mill may be taken to be as follows :—

Retted and dried flax straw	100·00
Scutched flax therefrom	14·84
Fine tow	3·32
Coarse tow	12·33
Waste or shive	69·51

A scutcher in an Irish mill turns out about 1,000 stones of flax in a season of twenty-six weeks. His wages average about 1s. 3d. per stone of scutched flax.

Flax scutching in Japan is carried out in a much more business-like way than it is in Ireland. The retted straw is weighed out to the scutcher in parcels of 40 lb. Each parcel is passed through the rollers separately and delivered to the scutcher, who when he has scutched it weighs in the scutched flax. If it is found that his yield is above the average, i.e., 20 per cent., he receives a bonus of ½d. for each per cent. above 20. On the other hand, if he makes too much tow and has, say, only 18 per cent. yield, his rate is reduced by a like amount. In Japan the scutch mills have thirty to forty stocks, and a spirit of healthy rivalry exists among the scutchers.

In the larger Continental scutch mills about 150 hands are employed. The system of weighing out the rolled flax straw to the scutcher is frequently practised, and serves as a check on the man's work. The average output of cleaned fibre by each scutcher per day is about 3 stones.

Co-operative scutch mills are common in Belgium, and fitted up with up-to-date machinery. Each shareholder owns one or more stocks, and usually scutches his own flax. The tow is forfeited to the society for the repair of the machinery, rent, &c., and the profits, if any, are divided among the shareholders at the end of the year. The price charged for scutching is about 1d. per lb. if the tow is taken away. If the tow is left, the use of the mill is given free to the member who is having his flax cleaned, but during this period he is responsible for payment of the scutchers employed.

Under pre-war conditions scutching of Irish flax cost 20 per cent. of its market price. Under war conditions, even at a cost of 2s. 6d. per stone with the tow, or 3s. per stone without the tow, the cost of scutching represents less than 10 per cent. of the value of the scutched flax.

In Holland and Belgium the pre-war cost of all operations, from the rippling of the seed to the baling of the finished flax and tow ready for the spinning mill—viz., rippling, bundling, retting, drying, breaking and scutching—is £3 10s. per ton of straw (basis two steepings).

Some Irish farmers want their flax to weigh heavy, and so do not encourage the scutcher to clean it properly. They evidently have not considered how light "shives" weigh, and how much they lose by keeping them in the flax. In 100 stones of flax, if the shives are left, there would not be more than 14 lb. of shives. Say, for instance, they get 20s. per stone, bringing in £100, if the shives were removed they would have 99 stones selling at 24s. per stone. In the one case they receive £100 and in the second £118 16s. Have they not sold their shives dear?

Although hand scutching has practically died out in Ireland, in the "blue" districts of Holland and Belgium where the farms are small, hand scutching is still pretty general. One man working with a hand roller and a hand scutching blade can clean about 1½ stone of flax per day.

The by-products of scutching are rug, tow and shives. Rug is the coarse dirty tow made in the first cleaning of the flax, tow the short fibres cut away by the finishing handles, and comparatively clean and fine, while the shives are of course the broken-up woody matter of the stem, which may be burned or returned to the soil as manure.

Until recently scutch mill owners charged a comparatively low price for scutching and kept the rug and tow produced, rescutching and selling the rug and tow at the end of the season, and thus making a considerable profit. Now that tow is so valuable, farmers are paying a higher price for flax scutching and demanding possession of the rug and tow, for which the millowner charges 20s. per cwt. for rescutching, the product "targed tow" being now worth 80s. per cwt. in the market. In its rough state the market value of rug is now about 20s. per cwt., and of fine tow 45s. per cwt. Rug is rescutched or targed in wads or mats in a somewhat similar fashion to flax, over the same handles set rather wider.

APPENDIX.

Early in 1918 British and French flax spinners began to debate among themselves as to what the effect on the supply of flax would be owing to the secession from hostilities and the consummation of a separate peace by Russia.

Every flax-spinning country has hitherto been dependent to a greater or less extent upon Russia, which exported before the War about one-half of her production. The following were approximately the pre-war figures of supply:—

Russia	400,000 tons
France and Belgium ...	50,000 ,,
Ireland	10,000 ,,
Holland	10,000 ,,
Germany and Austria ...	30,000 ,,
Total	500,000 tons

The Scotch linen trade took practically its whole supply of raw material from Russia, and bought yarns made from Russian flax in Belgium and France.

In the Irish linen trade about one-fifth of the flax used was Irish grown, over three-fifths came from Russia, and the remainder from Belgium and Holland.

The advance of the Germans into Russia and particularly the capture of Reval hence naturally give cause of alarm. It has at this time been realized by the trade that the Germans have grabbed the white flax, Motchinetz, or water-retting districts of Livonia, Esthonia, Courland, Fellin, &c., and the precious fibre which they grew. Before this booklet gets into print it is quite possible they may be in Petrograd and have laid hands on the whole of the flax in the lower districts. Once in Petrograd they will have control of the railway to Archangel, and can put a stop to the possibility of export from that northern seaport.

Early in 1918 saw a largely attended meeting representative of all branches of the Irish linen trade, summoned to Belfast to consider a scheme to grapple with the problem of providing the coming season's flax supplies. The trade has with this object been organized on the lines of a representative limited liability syndicate to be responsible for a guarantee of

£200,000, subject to obtaining £600,000 guaranteed by the Government, the money to be expended in renting land and cultivation of a quantity of flax over and above the expected increased acreage of farmers and sowing Canadian common seed. For this land the rent is to be £20 per acre for the six months, together with an additional £4 per acre for labour of sowing, &c. It is estimated that this amount will be sufficient to cultivate 20,000 acres, harvest, ret, scutch, and deliver the fibre to the Control Board.

Even if this scheme is successful, which is by no means certain, it only means a supply of a further 4,000 tons, still leaving a deficit of over 30,000 tons if the supply of Russian flax is entirely cut off. If the worst takes place Scotch spinners will be in a desperate plight, and Irish spinners little better off.

An ample supply of *cheap* raw material is essential to the prosperity of the linen trade. It is an abundance of cheap labour that makes Russian flax comparatively cheap. Owing to the climate home-grown flax will always be *better* than Russian, but it can never be produced so cheaply. Two possible fields for flax cultivation on a large scale are Canada and India. Experiments are now being made in the Province of Ontario, Canada, but the cost of production proves to be about the same as in Ireland. Perhaps the most promising opening lies in India, where native labour is cheap and plentiful.

Mr. W. H. Webb, President of the Ulster Linen Merchants' Association, insisting recently on the necessity for a larger supply of Irish flax, said that this could only be accomplished through an organized scheme, for under present conditions its production had about reached a maximum.

Another merchant pleads for a really scientific treatment of the flax after being pulled, believing that farmers should not be asked to become experts on the after treatment of flax, but should specialize in the growing of the crop both in quality and quantity.

MR. H. R. CARTER'S SCHEME.

Writing to the editor of the Belfast *News-Letter* on January 14, 1918, Mr. Carter says :—

"Sir,—Mr. W. H. Webb, President of the Ulster Linen Merchants' Association, in a recent letter to the press, rightly insisted on the necessity for a large supply of Irish flax. This, he said, could only be accomplished through an organized scheme, for under present conditions its production has about reached a maximum. As one who has studied the question closely for the past twenty-five years, and been in close touch with the raw flax industry both at home and on the Continent during that time, I venture to submit the following scheme to relieve flax growers of the labour of retting and grassing, which are not strictly agricultural operations, and at the same time to greatly improve the colour, handling and scutching of Irish flax. Spinners and other interested parties of intelligence are now agreed that the waters of the River Lys, which produces the world's best flax, possess no hidden virtue of their own, their efficiency being due to their softness and slow rate of flow, but more particularly to the quantity of flax which is steeped in the river, and to the cultivation therein of the retting microbe, which attains its maximum activity in the neighbourhood of Courtrai. Spinners are, further, unanimously of the opinion that hot-water retting in tanks, although a saving in time, produces fibre of inferior yielding and spinning quality, and is not to be advocated. Taking these two points for granted, therefore, why not convert one of our disused canals into an Irish "golden river"? It could easily be done, just as at Selby a branch of the river is being successfully utilized. Select a stretch between two or more locks in a part of the country where flax is largely grown and where the fields on either side are suitable for drying and grassing the straw. If not already closed, close the canal to all traffic between April and October. Make the locks quite watertight; produce a current by means of syphons, ball-cocks, and overflows, the rate of flow being that known to produce the best results (of which I have data) and under strict control. Build jetties provided with lifting gear to launch and land crates containing the flax straw, after the Courtrai fashion, and a towpath, so that they may be hauled to their proper position in the stream. Erect scutch mills at the other side of the drying-fields. Encourage neighbouring farmers to grow flax, and buy it on foot from them if necessary; also, buy up all the best straw from all parts of Ireland, and convey it to this central rettery by those parts of the canal on either side of the stretch being utilized as a rettery. Bring together scutchers from all parts of Ulster, and supplement their number by skilled Belgians and Dutchmen. Employ them on the canal and in the drying and pulling fields, during the summer months, and in deseeding and scutching during the remainder of the year. If this scheme were skilfully carried out we would have no need to send hundreds of thousands of pounds annually to Belgium and Holland, and it would be spent in our own country, to the immense advantage of the workers. To get over the difficulty of pulling an increased acreage of flax in a limited time, if a successful pulling machine has not yet been invented, I would suggest the complete or partial closing down of the flax-spinning mills during the pulling season and the turning out of the dust-choked workers into the healthy country air of the flax fields at a usually agreeable time of the year. They could be set to work in gangs under their own foremen, who might be given a short preliminary training. In any case I know by practical experience that those who have been trained to handle flax fibre carefully in the mills naturally handle the flax straw much more carefully and skilfully than the farm-yard hand."

Mr. J. A. Campbell, of Furzefield, Donaghadee, writing on the 17th ult., said: "I am prepared during the coming season if I can obtain proper seed (and I know a good many farmers who will increase their acreage also if the Government state they require it) to sow anything between 15 and 50 acres, provided some guarantee is given that the flax, when properly grown and pulled, will be purchased by the spinners or some responsible syndicate on their behalf."

Mr. James Davidson, Linwood, Donaghadee, wrote: "This is a very sensible proposal, and coming as it does from a practical farmer, it is one that should commend itself to everyone interested in the extended cultivation of flax. The farmers' part of the work should cease when he has cultivated the ground, sown the seed, weeded and pulled the flax, and the after processes of retting and scutching should be scientifically treated by some such means as suggested by Mr. Campbell. If such a company could buy the flax from the farmer and pay for it the day it was pulled, it would do more to extend the acreage than any Government grant."

"Owen Varna suggested that retting should be done in tanks which could be kept at an even temperature, somewhat higher than our mean summer temperature. He says that most farmers agree that the temperature has an effect, and it is not unlikely that the warmer summer climate of Belgium has contributed a share in making the River Lys famous as a flax-retting centre. If these factories were established on the sites of disused mills now so common throughout the country, there would be no difficulty in having a regulated flow of water throughout the ponds as suggested by Mr. Carter. It would require such a factory in every district, so as to save cartage and handling expenses. I am afraid that the suggestion of using the canals is not workable, as in addition to having to cart the flax straw for a long way traffic could not be stopped without an Act of Parliament. I believe modern

methods of drying would be more economical than spreading on grass, and there would be no risk of a wet season spoiling the flax, but practical experience only could prove it to give as good results as grass drying."

Mr. Thos. M'Connell, Ballinderry, writes on the 17th ult.: "Mr. Campbell's suggestion in your paper appeals to all intending flax growers. There are so many new growers of flax in all parts of the country that the want of the scientific knowledge hinders the production of the proper quality of fibre amongst the inexperienced. Surely there is great need that the spinners should change their tactics and give encouragement to the farmers and buy the crop as grown, and take the responsibility of all subsequent labour. The spinners have plenty of help, and, as Mr. Carter suggests in his letter of 14th inst., the dust-choked workers would benefit in the healthy work of pulling, steeping, spreading and lifting the crop. The old stubble land of last year lends itself as most suitable for growing a good strong crop of flax, which will be so necessary and so much required for the making of aeroplane linen, as well as to keep our mills and factories working. The possibility of any imported flax this year may be very remote, and for this reason and the present scarcity it is surely up to the spinners to give a helping hand. Many farmers are anxious to know how many owners of spinning mills and others engaged in the linen industry have in the past been in the habit of growing and producing flax on their own land. It is interesting to note that the Government have decided to make an effort to grow 10,000 acres of flax this season in England, and to assure the successful growing of this quantity farmers are guaranteed a minimum of £14 per acre. In the year 1864 Ireland grew over 300,000 acres, which is the highest record for the past fifty years. In the years 1898 and 1899 we have the lowest record, viz., a little over 34,000 acres. Last year we had somewhat over 107,000 acres, and there is no reason, with a substantial bonus per acre, that we should not grow over 200,000 acres this season."

On the 25th ult., Mr. Carter replied:—

"Sir,—Referring to recent correspondence *re* flax, 'Owen Varna' is quite right. The time required to ret flax depends upon the temperature: the higher the temperature the shorter the time required. It is when the temperature is raised to such a degree that retting is accomplished in about four days that damage is done to the fibre. The maintenance of an even temperature, somewhat higher than our mean summer temperature, would make the time required for retting approximate to seven to ten days, and give a good spinning and yielding fibre. This could easily be done through the feed water required to produce the regulated current, which I have proposed should be given to a section of one of our canals, some of which, I believe, are very little used indeed; in fact, my idea originated through reading in the paper not so very long ago that it was proposed to pass an Act of Parliament to close down a certain Irish canal—I forget which—as it was so little used. 'Owen Varna's' suggestion of smaller and scattered retteries does away with all the benefits of a central rettery and a centralized flax industry which has made Courtrai so rich and famous. As I pointed out, the quantity of flax retted in a certain stretch of water has not a little to do with the success of Courtrai retting. Cartage, handling expenses, and carriage on straw would be reduced to a minimum by carrying out my suggestion of utilizing the canal to bring up the dried straw to the central rettery, and of encouraging farmers within easy reach of that canal, which would probably communicate with the Midland, Southern, and Western counties of Ireland, to grow flax. This industry would then create traffic for a canal about to be closed for want of traffic. In any case, it would be well worth the Government's while to stop through communication for three months in the year to encourage the industry and to provide material for aeroplanes, &c. To Mr. M'Connell I would say that I only suggested that mills should arrange to let certain sections of their hands assist farmers in pulling the crop. They could hardly be spared for more than two or three weeks at the outside. I would also ask him where he can find the seed to sow 200,000 acres this season? To Mr. James Davidson I would say that the Fibre Corporation, Dromara and Newry, has been in a comparatively small way for some years past buying flax straw from the farmer.—Yours, H. R. CARTER.

"25, *Donegall Street, Belfast, January* 25."

TANK RETTING.

The retting of flax in tanks with water at a temperature above the normal with a view to reducing the time required to ret has frequently been done. The following is a description of one of the earliest of such processes, i.e., that of Schenk:—

"DESCRIPTION OF AN OLD IRISH FLAX RETTING ESTABLISHMENT.

"The following dsscription bf Schenk's flax rettery once established on the Newport River, Co. Mayo, is taken from a report by Mr. M'Adam, Secretary of the Old Royal Belfast Flax Society. He says: 'The tenements, containing the retting vats and drying shelves are simple wooden sheds, of cheap construction. In one end of the building are four vats, set parallel to each other, the length of the house. They are made of inch deal in the form of a parallelogram 50 feet long, 6 broad, and 4 deep. There are false bottoms perforated with holes; underneath these are introduced the steam pipes crossing the vats, and having stop-cocks at their entrance, by which the steam can be let on from the main pipe, as required. The steam is generated in a small boiler, which also serves to turn two hydro-contractors. The flax is packed into the empty vats on the butt ends, in a half sloping position, precisely as in the case of the steep pool, only one layer being in depth. The water is then let in and a frame fastened over the top of the flax, answering the end of stones or straw in the steep pool—the prevention of the rising of the flax in the course of fermentation.

"The steam is then let into the pipes by turning the stop-cocks, and the water is some eighteen or twenty hours in becoming heated to the required point, 85° to 90°. The fermentation then commences and no further steam is required, the action going on till the flax is thoroughly retted, which is in forty hours afterwards, being sixty from the time of admission of the water. At the end of the sixty hours the flax is taken out, the water allowed to run off, and the vat permitted to cool. The same process is then repeated with fresh water and fresh flax.'"

By Watt's process boiling and crushing are substituted for fermentation, the flax straw being first steamed and then crushed between heavy metal rollers.

Buchanan's process was intended to be an improvement on Watt's. In it the solvent power was due to hot water occasioned by the condensation of steam, the steepings being effected by repeated immersions in a tank of heated water, kept at a temperature of about 160° F., only four hours being required for the operation.

In Germany, specially fine flax has been steeped four or five days in a warm mixture of milk and water. Sometimes an alkaline ley made from wood ashes or other chemical agents has been tried to hasten the retting process, but the action of soft water, and the production of fermentation in the ordinary way, is, if rightly conducted, probably the best mode of accomplishing the desired object.

"As early as 1808 a Mr. O'Reilly proposed that instead of steeping flax straw in the usual way, the stalks should be boiled in water or in a caustic mineral alkaline ley. Alternately he proposed to suspend the flax straw in a steam-tight chamber with a boiler attached from which steam was to be introduced, that from a weak caustic alkali being thought best for the purpose." Hence O'Reilly's idea clearly foreshadowed both Schenk's and Watt's patents.

General view of a Legrand Patent Rettery on the Lys.

Perhaps what might be termed the first modern attempt at industrial tank retting was that of Jules Van Mullem, 1882, at Harlebeke. His object was to replace retting in the River Lys itself by retting in a series of tanks situated near to the river and supplied with water from it so as to produce better results by doing away with several disadvantages of the River for retting. His patent claimed a methodical and continuous system of retting in tanks by means of ordinary river water filtered and heated to get rid of matter likely to injure the flax. He employed a series of eight water-tight tanks communicating one with the other, and proceeding step by step with a feed and discharge pipe, both fitted with stop-cocks or valves. In each tank the opening into the preceding tank and into the feed conduit was near the top level, while that into the following tank and the discharge was at the lower level.

It was thus possible to produce through the flax straw in each tank a continuous water circulation in one direction. The pure water entering into the first tank flowed on successively into each of the other tanks unless one or more was skipped for cleaning or emptying, &c. Matters were arranged in such a way that the freshly entered flax straw was first treated with the water which had made the whole circuit, next by the water which had been through all the tanks but two, and so on until, the retting nearly finished, it got pure water. In this way fermentation was hastened at the start and retarded at the finish. Thus one inconvenience of retting in the Lys, where all the flax cannot have the best position, was done away with. The retardation of retting at the finish made it easier to determine the exact period when the flax had been sufficiently retted. A saving in water was also effected, the water discharged only being lost and no more being required for the series of tanks than for one. Neither was the water of the river contaminated by pectic acid. The water of the river, often charged with black matter, was first decanted in a tank, then filtered and the clean water passed to the retting tanks. The straw and sacking used in the Lys to protect the flax against dirt is thus not necessary to the production of a nice yellow colour, although it was found that the straw retted in the tanks lost less weight than it did in the river, and yielded better at the scutch mill; this system did not extend, we do not know why.

Mr. Foster, of Selby, Yorkshire, was at one time a large flax grower and cultivated up to 3,000 acres annually, the straw being retted and scutched under his own supervision. His method consisted in first crushing the green straw between rollers and then retting it in vats of lukewarm water.

For several years before the outbreak of War hot water retting was being extensively carried out in central retteries in Holland, Friesland, Germany, Austria, Japan, &c., and even along the banks of the river Lys itself. The latter fact, which may seem strange, will be understood when we say that there is not sufficient retting accommodation along the Lys, the renting of a part of the bank being difficult and expensive. The shorter time required for hot water retting and the small

INTENTIONAL SECOND EXPOSURE

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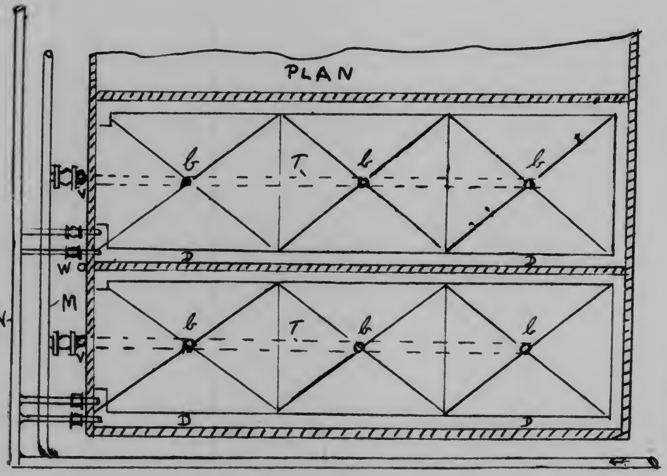
The most successful hot water retteries have been constructed upon the Legrand van Steenkist principle and there are nine or ten such retteries along the Lys.

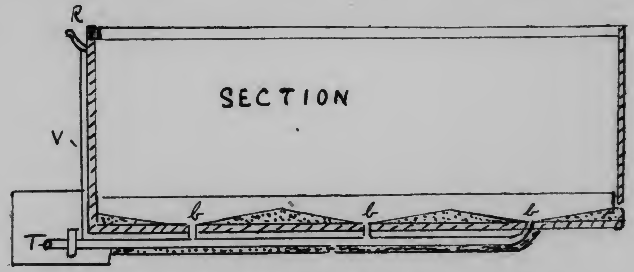
The following is a description of such a rettery. The retting tanks (*see* section and plan), measure approximately 33 ft. by 10 ft. They are simply constructed of reinforced concrete, four walls, a floor formed of inclinations towards the central points *b*, connected up with the iron pipe T, which can be used either to fill or to empty the tank and which branch into the main ducts M which surround the tank. The latter is also surrounded by a pipe D of double square section (*see* plan), also made of cement. At equal distances along this pipe are oblique openings which give to the water entering the tank a circular motion. They are connected with the duct N, and serve in conjunction with the pipe in the bottom to fill the tank. They are also used for another purpose, as will be explained later on.



Plan of a Legrand Patent Rettery.

Two vertical pipes V, opening into the same cement gutter R which run along the top of the tank, branch out from the pipe in the bottom. Between every two tanks is a down pipe W discharging the contents of the gutter into a ditch or pit. The combination of the pipes V, R and W thus serve as an overflow.

The cement ducts D serve as supports for an openwork floor upon which the bottes or sheaves of straw are built on end when the tank is empty just as the crates are filled upon the Lys. When the tank is filled with straw, water is admitted through the three pipes. Degumming begins and when finished the brown saturated water is run off by the discharge pipe and the tank is again filled to commence the second stage, or retting proper. When fermentation sets in the water becomes more and more acid and must be diluted. To do this water is admitted in the desired quantity by the double side duct. This water entering by the oblique openings O, rises with a circular motion, and as it rises a corresponding descent of saturated water takes place, the latter escaping by the pipe in the bottom, rising by the vertical pipe V to the gutter R, and flowing off by the down pipe W.



Section through a Legrand Patent Rettery.

Let us here remark that the water which thus runs off towards the end of the retting process can be used for degumming in a tank of fresh straw. Its utilization in this way is arranged for, it being only necessary to stop up the pipe W, when the water passes by the pipe T to fill the next tank.

Scutch mills are usually combined with these patent retteries. Above the latter, constructed of reinforced concrete with flat roof, are two water reservoirs side by side. The second is smaller than the first and at a lower level; water is pumped into the first tank, from thence it flows into a boiler of the water heater type, which raises it to a temperature of 95° F., as shown by a thermometer placed in the outlet pipe. The warm water rises and fills the second tank. From thence it can, simply by opening a valve, flow into the retting tanks.

The only fuel employed is the shove and waste from the scutch mill.

Such a rettery produces per season and per square yard of floor surface, 62 cwt. of flax straw retted twice.

The retting season is counted as six and a half months, i.e., March 15 to October 1.

The pre-war cost of such a retting was £5 per square yard, the ground and drying fields not included. The revenue of the rettery, let at the same rate as those on the Lys, i.e., 5d. per cwt., is 25 per cent. on capital. The building cost for a rettery one layer deep, 10s. 7d. per square yard, and for a rettery two layers deep, 12s. 3d. per square yard.

The quantity of water required per cwt. of straw to be retted either in one or in two operations, i.e., single or double retting, is 108 cubic feet. The heating of these 180 cubic feet, waste steam being utilized, costs 3¾d.

The tanks are filled and emptied of flax straw through water-tight iron doors. Except for the difficulty of making the doors or gates water-tight it would be much more convenient were the door made big and wide enough to permit of a horse and cart backing in as into a silo.

The hot-water retteries built at Selby, Yeovil and Dromara are but poor imitations of the Legrand system. In the former the tank has to be filled and emptied over the top or edge.

The Feuillette process bears a striking resemblance to M. Legrand's old process which proved too costly.

For some years chemists have been studying the retting microbe with a view to employing a better knowledge of its action industrially in the more rapid, effective and economical retting of flax, &c.

The Rossi process is based on the alleged discovery that the use of a gas current through the liquor while retting is going on regulates and increases the retting effect of the pectic aerobic microbes. Professor Rossi uses several varieties of these retting microbes at Portici. A pipe fitted with a valve admits the retting microbes to the retting tank, while a pipe entering at the top passes down the centre to a level beneath the false bottom and is used to pump in a current of air or gas which bubbles up through the liquor and the fibre under treatment which is kept submerged mechanically.

The Americans have made many attempts to supersede retting by chemical action of acids, alcohol, petrol, soap, &c. Their latest involves the use of solvents to effect the release of the pectose from its association with the fibre and non-fibrous elements of the flax straw. Kerosene, naphtha, benzine, carbon tetrachloride, ethyl trichloride, &c., are used with water at any ordinary temperature or in the form of steam, depending upon the specific gravity of the solvent used.

It seems as if any great increase in the cultivation of flax in Great Britain and Ireland can only come with the invention of a flax-pulling machine and with the establishment of central retteries and scutch mills.

Retting and scutching is a trade in itself and a farmer can never hope to attend to the retting of his straw with the results that can be achieved by the centralization of the process.

The advantage of central retteries are that instead of individual growers taking up the critical operation of steeping once a year, there is a regularly organized establishment where this business is regularly carried on and the workers consequently become very expert.

Flax retting on the Lys is in fact a central rettery, flax straw being brought to it by canal from Holland and France, and other parts of Belgium. Thousands of hands are there employed in the industry and nearly £200,000 paid out in wages annually.

EXTRACTS FROM ANCIENT AND MODERN WRITERS ON FLAX.

"Land reclaimed from the sea is often very suitable for flax production, containing as it does a large percentage of silica and siliceous sand and organic matter rich in nitrogen."

The chemical composition of the flax plant, according to the late Professor Hodges, Queen's College, Belfast, is:—

Water	56·64	per cent.
Organic matters	41·97	,,
Ash	1·39	,,
Total	100·00	per cent.

One hundred parts of Irish flax straw give 0·53 per cent. of nitrogen and 3·20 per cent. of ash. This ash contains:—

Potash	20·32	per cent.
Soda	2·07	,,
Chloride of soda	9·27	,,
Lime	19·88	,,
Magnesia	4·05	,,
Oxide of iron	2·83	,,
Sulphuric acid	7·13	,,
Phosphoric acid	10·24	,,
Carbonic acid	10·72	,,
Silica	12·80	,,

"In normal times the relative values of Russian, Irish and Courtrai flaxes are approximately :—

(1)	Courtrai flax	£80 to £100 per ton
(2)	Irish flax	£60 per ton
(3)	Russian flax	£40 per ton

"Dutch flax is intermediate between Courtrai and Irish. The fine flaxes are used for damasks and fine linens; the coarser qualities, from Russian flax, for heavy canvas and sail-cloth."

In 1857 Brown wrote: "I ask if it would not be a great national object to increase the culture of flax in the United Kingdom, and that to such a degree which would supersede, in some measure, the importation, or at least reduce the price, of foreign flax and flax seed to the extent of one-fourth of the value and quantity, say to the extent of £5,000,000 or £6,000,000 yearly, whereby a great increase would be profitably made at home to the value of land. In short, all the advantages incident to the augmentation of home produce and manufactures would be secured to our own country, instead of going to foreigners."

"The average possession of the Flemish farmer is only from ten to twenty acres, and in most cases they grow and sell flax sufficient to pay their rent."

"Canada has both a suitable soil and climate for flax."

"The total number of known acres under flax cultivation is approximately 15,000,000, but out of this number only about 5,000,000 acres are cultivated for fibre."

The average yield of Irish flax per acre may be taken at 29 stone = 29 × 14 = 406 lb. of long scutched flax and 203 lb. tow.

The average value of this tow is in normal times only ½d. per lb.

The average cost of production per acre in Ireland would be, say, £8, so that the long flax costs—

$$\frac{(8 \times 240) - \frac{203}{2}}{406} = \frac{88{\cdot}5}{406} = \text{nearly } 4\tfrac{1}{2}\text{d. per lb. to produce.}$$

And must sell at 5s. 3d. per stone to clear cost.

Taking the average value of Irish flax at 7s. 6d. per stone, the profit would be 2s. 3d. per stone, or £3 5s. 3d. per acre.

The fibre of unsteeped flax is white or only tinged with a yellow matter immediately soluble in water. The colouring matter of unsteeped flax is easily discharged. The discoverer of a method of preparing flax without retting and at the same time preserve the fibre and all its requisite spinning qualities intact will confer a boon on both the growers and manufacturers of the fibre and be a benefactor to his country.

"Each blossom of the flax plant contains five stamens or fructifying organs called the male part of the flower, and also five pistils or terminating points of the embyro fruit, forming the female organs. Each stamen is tipped with a little roundish head called an antler which, when mature, sheds a fine dust called the 'pollen.' The pollen coming in contact with the pistils causes the seeds to grow and become reproductive.

"Some thirty years ago one witnessed the cultivation of flax upon almost every little farm throughout Ulster. At that time in Monaghan the country seemed dotted with little smokes arising from the flax kilns throughout the county in the autumn months. The flax was then dried over a turf fire in those kilns, and beetled with hand beetles, or rolled in preparation for the scutching. The latter was usually done by girls with the aid of a flat board containing a handle, and with which they scutched the flax on an upright strong board secured to the ground by a sole, and known as a stock. Sometimes as far as twenty girls would be engaged, with as many stocks and handles, at one farmer's house. Each girl could scutch about one stone per day of finished flax on an average. The house was known for the time being as a scutch house, and the girls' sweethearts, and all the boys for miles around, would turn up at night for the purpose of having dances, songs and enjoyment. This process of handling flax was slow, but neat, and always capable of taking out without loss every available piece of the fibre for sale. The prices per stone averaged from 5s. to 7s. in the market, and the yield, I believe, exceeded our present day yield on the average.

"In a normal year—and 1913 is a good average—the entire flax supply used in Irish manufactures is 55,000 tons; of this total, somewhere over one-fifth is Irish grown, much over three-fifths comes from Russia and the remainder from Belgium and Holland."

An entirely new departure was made by linen manufacturers, in 1918, renting suitable ground from the farmers for flax cultivation. About 4,000 acres were thus rented by the trade in the province of Ulster and another 1,000 acres in other parts of Ireland. For this land the rent paid was £20 per acre for the six months, together with an additional £4 per acre for labour. Canadian common seed was used.

HARVESTING.

In pulling, the long and short stems should be kept separate as much as possible and the root end even. A small quantity should be held with the left hand and pulled with the right hand placed about halfway down the stalks. The handfuls should be really placed over each other, so as to remain distinct, and no earth or clay should be allowed to remain on the roots.

When the flax is pulled it should be made up into small sheaves or bundles tied slack to let the air have free action through them. These should be set up in stooks of twelve sheaves with the bolls up and allowed to remain from two to four days to ripen and firm. In very sunny weather little time is required for this purpose, but if the crop has been heavy and lodged it will require a little extra time, as it should under such circumstances be pulled a little sooner than if it had been standing.

"Pull the flax when the fibre is in the best state for your purpose, and still take off the seed bolls, which under ordinary circumstances will amply repay the outlay."

The Dutch method of pulling consists in catching the flax close to the bolls. This allows the shortest of the flax to escape with the next handful. The puller draws the short flax and so keeps the long and the short separate to be steeped separately.

SIX WEEKS' FLAX PULLING.

Experiences of a College Girl in the Somerset Flax Fields.

The following extract from an article which appeared in a recent number of *The Englishwoman* may interest and amuse. Miss Goss, a London University student, there recounts her experience of flax pulling in Somerset. Eager "to do her bit" and "incidentally to consummate" visions of green fields and juicy apples and friendly cows and horses, and breeches and leggings, she interviewed the Secretary of the Women's Land Union in London last summer.

"How about flax pulling for aeroplanes in Somerset?" the latter said. "The Government has commandeered all the flax grown in the district, and we are sending down one hundred workers (mostly college girls). It's hard work, you know."

"Oh, I don't mind that," Miss Goss replied, airily.

"Well, sign here, and pay 12s. 6d. for your enrolment fee and the return ticket to Waterloo, please."

Leaving a few minutes later plus a khaki armlet with the inscription "Women's National Land Service Corps," the rest of the afternoon was spent in buying khaki overalls, gaiters, sun bonnet, &c. The following Monday she left for Yeovil. It was a nasty wet day, and, arrived there, there was no one to meet her, and she had not the faintest idea how to get to Barwick House, the "empty country mansion" where the War Office was to billet the girls. Directed by the stationmaster, however, she set out in torrents of rain along a very muddy lane, and after half an hour's brisk walking came to the house and walked through the open door into a hall full of tin cans and cups and trestle tables. A battered piano stood by the door, and facing it was the large blue triangle of the Y.W.C.A. who ran the canteen.

Some one in a blue overall emerged and led her up some very noisy stairs on to a wide landing. Here she was confronted with a medley of suit cases and battered trunks and mattresses.

"'All the rooms are called by different names,' said Blue Overall. 'This landing is '"Pandemonium."'' We passed The Sardine Tin, Olympus, Valhalla, Arcadia, and finally arrived at The Hotel Cecil, a small room in which eleven slept on straw mattresses and covered with an army blanket.

"In the morning, after hurriedly dressing, I got down to breakfast. Soon after breakfast, some small cars, two large motor lorries, and a shut-up affair known as the 'Black Maria' rolled up, and we packed in. By 8 o'clock I found myself in a flax field, pulling for dear life. We worked in gangs, each under a gang-leader. The flax had to be pulled up by the roots. This naturally involved much stooping, and resulted in backaches of the most fiendish description. My gang-leader hovered near me for a time, showing me how to pull the flax by a series of small jerks, instead of the herculean efforts I first expended on it. We each had a strip of some 2 yards width. When on each occasion I straightened up and looked hopefully across the field I found I seemed to remain in exactly the same position; and on looking back I found I had left heaps unpulled. Talk about dragons' teeth! I am sure that flax could beat any dragon's teeth to fits. It grew by magic before and behind the desperate puller. At 11 a.m. we stopped, and each ate an enormous sandwich. At 11.30 we were back at work. At 1.30 p.m. we were given half an hour's rest. At 3.30 a girl fetched tea in a bucket for the gang. After tea, we worked again till 6.30 p.m., when the motors came to fetch us home. The after tea work was a little better than the pulling, for we 'gaited' or stood up the pulled bundles in stooks or 'gaits.' Two girls did the gaiting and the others 'served' or carried the bundles to them.

"On Saturday we went off after work to visit the Westlands Aircraft Factory, where the linen from our flax was used for aeroplane wings. The finer the linen the greater is the speed of the machine, I believe.

"The very worst remembrance I have of flax work is that of laboriously 'turning' acres of mouldy, wet flax, festooned with fat worms, through an entire day.

"Later on the work became easier. We 'tied' the gaited flax into sheaves ready to be loaded and carted away to the factories. If they were not carted the same day they had to be piled up in little pagodas, known as wind-mows. At first our earnings were very small—7s. to 12s. weekly—and our canteen charge was 13s. weekly. Later, when we 'tied,' we got more—16s. to 25s. Those were great days.

"Our numbers gradually dwindled down until September 8 found two solitary people finishing a field together after the departure of the others. On the night of the 7th the chief farmer of the district and local secretary of the Flax Growers' Association had us all to supper and gave us a good time. We arrived in town on September 10, very brown, very fit, and absolutely uncivilized."

DESEEDING.

The best ripples are made of $\frac{1}{2}$ in. square rods of iron, placed with the angles of the iron next to the ripplers, $\frac{3}{16}$ in. asunder at the bottom, $\frac{1}{2}$ in. at the top, and 18 in. long to allow of sufficient spring and to save much breaking of flax. The points should begin to taper 3 in. from the top.

"The Dutch farmers always save the seed of the flax, and value it as high as £8 or £9 per acre. They say that this is done without any injury whatsoever to the quality of the fibre. Both in the Netherlands and France the farmers are very particular in the steeping of their flax; only one layer is put at once into the lint holes and the air and light are most carefully excluded. This causes much more evenness in the colour of the fibre than is usually obtained in the flax of Ireland, where this precaution has never been perhaps sufficiently attended to."

"It should be possible to save at least four bags of seed per acre."

"A bag of flax seed weighs 200 lb."

DEW-RETTED FLAX.

Russia is the largest producer of dew-retted or Slanetz flax, which is exported from Archangel and Petrograd by ship and rail. France has hitherto been the largest importer of dew-retted Russian flax. Continental spinners of eminence have always shown a preference for dew-retted flaxes, whereas Irish spinners before the war invariably fought shy of them, because the yarns when made would not boil a clear yellow colour as water-retted flax yarns will. Since the war broke out, however, both water-retted and dew-retted have been used without any objection being raised. A good deal of tow as well as flax comes from the dew-retted districts of Bijetsky, Kashin, Kama, Krasniholm and Ouglitch.

The chief centres for Flemish dew-retted or Walloon flax are Tournai, Namur, Ath, Leuse, Liège, and Gembloux.

French flax grown in Brittany and in the Bergues district is partly dew- and partly water-retted, being first partly dew-retted on the grass, and then finished in the dam.

FLAX DESEEDING AND DEW RETTING.

Mr. Lewis C. Gray, Administrator of the Flax Supplies Committee, Belfast, has communicated the following letter to the Press:—

"SIR,—As the question of dew-retting flax grown in Ireland is at the present moment of considerable interest to farmers in Ireland, and of great importance, looking to the necessity that all owners of 1917 flax or previous years require, in terms of the Order in Council recently published, to have same scutched and marketed by the 1st July, including the proportion of their crop saved for seed, I am directed by my committee to bring the following facts of an actual test that has been made before you, in order that the general body of farmers may be made aware of these and adopt the procedure outlined: A flax-grower in County Down recently delivered to this committee 9 stone 9 lb. of flax scutched from straw from which his regulation amount of seed had been saved. The straw in question had been dew-retted by the farmer, and the procedure adopted by him in doing so was practically that as outlined in the leaflet (No. 29) issued by the Department of Agriculture and Technical Instruction for Ireland in which retting of deseeded flax straw is strongly recommended, and the procedure to be adopted is laid down as follows:—

"'The retting process takes about six weeks. Flax is placed on grass in the same manner as when spread after being taken out of the steeping pond, except that it must be more thinly spread. Every few days, according to weather, the straw should be turned over to allow of even exposure to the air and prevent discoloration. There is more danger of under-retting than of over-retting in this process, and the flax straw should be left on the spread ground until the straw can be quite easily rubbed away from the fibre. When taken to the scutch mill the scutching handles should be driven very slowly, as dew-retted flax requires very little beating to remove the shoves.'

"On receipt of the flax in question, the committee, in order that they might be in a position to judge and advise as to the suitability of this method of disposing of the deseeded straw, asked the firm of spinners to whom this special consignment was allocated to make a special report thereon. The firm reported that this particular lot of flax yielded as well in hackling as the average of water-retted flax, and cleaned up well. It turned out quite up to grade 2, at which it had been bought. The firm in question also reported that flax of this type would be quite satisfactory for the manufacture of aeroplane yarns. The committee are quite satisfied that there would be no comparison between flax dew-retted as above and fibre that had been scutched green without retting of any sort, and hope that farmers will adopt the 'dew-retting' method as outlined."

Later Mr. George R. Begley, who has had considerable mill experience in Russia, wrote to the Editor of the *Belfast News-Letter* as follows:—

"SIR,—I have followed with interest the correspondence in your columns on the question of dew-retting flax grown in Ireland, more especially a letter from the pen of Mr. Lewis C. Gray, Administrator, Flax Supplies Committee, in your issue of the 8th inst., wherein a report is given of an actual spinning test made recently with Irish dew-retted flax. I have always been of the opinion that great use could be made of this mode of retting in Ireland. The peasants in Russia have little difficulty in turning out a very good dew-retted flax, and as the average Irish flax is superior to the average Russian flax, the difference in quality should still hold good between Irish and Russian flax treated in the above manner. In certain districts in Russia, particularly Jaroslav, dew-retting has been brought to such a high point of efficiency by the peasants that there is no trouble at all in spinning to numbers as high as 130's weft; in fact, for a number of years it was spun to the same number against water-retted Courtrai line, with better results both as regards production and spin. From the standpoint of the spinner, and taking into account the handling the fibre would get in the home mills compared with what it receives in the Russian mills, I have no hesitation in saying that carefully dew-retted Irish-grown flax should be even a greater success than the water-retted Irish flax."

Under date March 12, 1918, Mr. H. R. Carter, of 25, Donegall Street, Belfast, wrote the Editor of the *Belfast News-Letter* as follows:—

"SIR,—Referring to letters on the above subject which have appeared recently in your valuable paper over the names of Mr. Lewis C. Gray and Mr. Geo. R. Begley—without in the least degree wishing to throw cold water on the scheme, if for the benefit of the trade, I would remark that my experience of dew-retted flaxes, gained in Continental mills, and the French have always been the largest users of such flax, is that wholly dew-retted flaxes are soft and weak. I say wholly dew-retted because some such flax, supposedly dew-retted, has been partly water-retted. My opinion on the subject is borne out both by Mr. Gray and by Mr. Begley, if one reads between the lines with technical knowledge. Mr. Gray says: 'The scutching handle should be driven very slowly,' in fact the flax is so soft that Irish blades run at the usual speed would knock it all into tow. Mr. Begley says that there is no trouble in spinning the best Russian dew-retted flax as high as 130's WEFT. Mark the word weft! Will dew-retted Irish flax, if fine enough for aeroplane yarns, stand the strength test?"

FLAX SCUTCHING.

Mill scutching, so called because the operation is effected in a scutch mill employing four or more scutchers, besides the roller man and strickers, &c. The mill is usually driven by water power, oil or gas engine.

Wooden or sheet iron covering surrounds the revolving handles like a drum, except at that point left open to introduce the strick into the notch of the stock. The sheeting in of the handles protects the worker from injury and keeps in the dust to some extent.

The scutcher holds the handful of rolled straw in his left hand, supported against the back of the stock. With the fingers of his right hand he constantly opens and turns over the fibres of the piece so that the beaters or scutching blades clean every portion of it.

A treadle scutch mill is often used in Belgium. The machine works on the same principle as in a scutch mill, but instead of being in series the machines are single, and the revolving blades, turned by one or two cranks and pedals, actuated by the feet of the scutcher himself. The operation is a tiring one, as both hands and feet are occupied at the same time, while the production is not up to that of the scutch mill.

Hand scutching requires only two tools—i.e., a vertical plank or board firmly fixed in a stand and a hand scutching blade of special form and consisting of a handle, a wooden knife blade and a heavy back portion to balance the blade and lend weight to the blow. The scutching blade itself is generally made of walnut. The hand scutcher holds a handful of the crushed or broken straw by one end with his left hand. He passes the other end of the piece into the notch in the vertical board and strikes this end with the scutching blade, which he wields with his right hand. The flat surface of the stock or stand guides the blade, which is thus forced to slide along the whole length of the exposed fibres. The scutcher should frequently turn the handful over and inside out, so that every portion of it may be cleaned. Now and then he should stop, lay down his blade, and open out the fibres with the fingers of his right hand, so as to bring to the surface those reeds of fibre which have not been touched, so that they may be struck in turn. The more frequently the flax is opened in this way the better it is cleaned. When one end of the handful has been cleaned he turns the piece and treats the other end in a similar fashion.

The first scutching or buffing having considerably reduced the bulk of the handful, the scutcher combines two or more of the small stricks, thus produced, together into one handful for a final cleaning.

New Methods of Scutching.

Numerous attempts have been made from time to time to improve on existing methods of scutching but have failed to find favour. The only part of the scutching process which has really been improved upon is the rolling or crushing of the straw preparatory to scutching it. No doubt this is better done now than it used to be, and more yield obtained from the handles.

In spite of improved ventilation the occupation of a flax scutcher is a dirty and dusty one, and difficulty is experienced in getting young men, the sons of farmers, &c., to learn the trade.

It looks, therefore, as if some more mechanical and automatic methods would have to be devised if the cultivation of flax is to be extended.

Some Recent Attempts at Improvement.

The following brief description of attempts at improved scutching methods may give someone an idea or save his time in unknowingly going over old ground.

In the early nineties there was exhibited under the agency of Mr. Hyndman at an exhibition held in the old White Linen Hall, Belfast, now the site of the City Hall, a flax scutching machine of particular merit. After being submitted to the crushing action of a set of rollers of rather finer flutes than usual, the handfuls of crushed straw were fed by hand between two endless steel holding and conveying bands. These bands resembled the steel blades of a band saw, but were carried around flanged pulleys lying horizontally. One side of each endless band travelled in the same direction along parallel lines about three inches apart. Between them lay on edge a fixed and smooth bar. As the upper edges of the steel bands were serrated and the piece passed over one serrated edge, under the fixed bar and over the other serrated edge, it was held quite tightly against a longitudinal pull. Hanging down from the grip of these holding and conveying bands the flax straw was struck by longitudinal beater bars carried on radial spokes like the barrel of a reel; these struck close up to the point where the straw was held, and the stems being thinly fed in, spread it out, and pretty thoroughly cleaned one side of the half of the piece. After travelling a distance of six or eight feet, the circular beater came to an end, while fixed guiding plates caused the depending fibre to pass on to another similar beating barrel turning in the opposite direction, which cleaned the other side of the same root end of the piece. The half-scutched piece was then passed out of the machine and was placed by hand by the turner or changer between another similar pair of conveyor bands which held the scutched portion of the piece while the top end was being scutched in two operations like the other end. The fully scutched fibre then passed out of the machine and was bundled up in suitably sized stricks.

We believe that the objection of spinners to the product of this machine was that the reed was left too whole, like hand-scutched flax. They like the reeds to be split up or the flax "milled" as it is by the heavy Irish blades operating upon often under-retted fibre.

In the writer's opinion the system did not get fair treatment, and would be worth trying again now that spinners are, it is hoped, more broad-minded and not so conservative as they used to be. Perhaps the next notable attempt at improvement was Crawford's, which the writer inspected in operation at Willowbank, Belfast. Mr. Crawford, after thoroughly crushing his straw, held the handfuls by hand, one end at a time, over a horizontal edge, while each end in turn was operated upon by a pair of rapidly revolving and intermeshed winged rollers. Combined with automatic feeding and conveying this system may yet prove a success.

The Adam's old scutching drums are nothing more nor less than the "Raspador" used in cleaning hard fibres (see Carter's "Decortication of Fibrous Plants"). Another system, tried both at home and on the Continent, is analogous to Crawford's, the scutching blades being attached to the bars of a vertical sheet hackling machine, the fibre being either carried in screwed holders or carried through by conveyor bands or ropes. As conveyor or holder bands, chains and ropes are in general use for holding fibre in all modern hard fibre decorticating machines, intending inventors would do well to study what is being done in this class of machine.

In the late nineties, M. Vallet-Rogez, of Lille, put on the market his combined system of flax scutching and hackling, and claimed an improved yield of fibre from the straw. His machine resembled a vertical sheet hackling machine and the speed and setting of the beaters could be changed to suit the nature of the flax straw being operated upon. Several rounds of hackles at the finishing end combed out the scutched flax, which was delivered in the form of dressed line. The first round of this part of the machine was fitted with notched hardwood scrapers to clean off sticky shove, instead of hackles.

The high state of efficiency which has since been reached by automatic screwing attachments for machines of this class should add considerably to the success of such machines to-day, but it is possible that a much less costly system of conveying and holding bands, chains or ropes will be found equally efficient. M. Vallet-Rogez claimed that his yield of *hackled* flax was equal if not superior to that of simply *scutched* flax from the ordinary scutch mill. Hence he argued that as flax scutched in the ordinary way only yields, say, 50 per cent. of dressed line from the hackling machine, his process resulted in a yield exactly double that obtained in the usual way. This result he claimed was due to the parallelism of the fibres being maintained all through and not destroyed by handling. There is no doubt a great deal in this point, which has been carried a step further by the inventor of the automatic spreader.

A recent Continental scutching machine of the Crawford type has its co-operating scutching drums provided with a radial and outwardly directed air blast to prevent the fibre from lapping round the drums, the shafts of which are made hollow and provided with radial perforations which are arranged so as to give the desired distribution of the blast, which is produced by an air pump or fan.

The mechanical decortication of flax without retting is, as we have previously said, useless in our opinion, for the reason that the pectic matter remains insoluble and in excessive quantity upon the fibre and prevents it from being subdivided by hackling, and also from being spun to fine numbers, as the gum cannot without fermentation be softened by maceration in hot water and the ultimate fibres drawn out and separated.

The most successful machine for the purpose is we believe that of Mr. Gray, of Glenanne, Co. Armagh, and made by Messrs. Combe Barbour, Belfast. In principle it is an ordinary set of flax rollers, combined with which are rapidly vibrating or vertically reciprocating frames placed in juxtaposition, between which the broken-up boon is rubbed off the fibre more or less completely.

IRISH FLAX SCUTCHING.

Evidence given before the Committee appointed in 1917 by the Irish Department of Agriculture to inquire into the charges for scutching and the disposal of tow affords some interesting reading. It appears that the scutch mill owner either charges the farmer a comparatively large fee, say 3s. 6d. per stone, for scutching his flax and allows him to take the tow produced away and sell it, or else he charges a much smaller fee, say 1s. 9d., per stone for scutching and keeps the tow. When the farmer pays the larger sum he can often sell the tow to the millowner at from 4d. to 8d. per stone to 10s. per cwt. for rough tow, and £1 per cwt. for fine tow.

Mr. Alex. Cromie handed in a return made out on the basis of scutching 8,000 stones in a season of twenty-six weeks. That return showed the actual cost of scutching to be 3s. per stone, allowing for interest on invested capital and 2½ per cent. depreciation.

Mr. F. B. Small considered that every stone of flax now cost him 3s. 3d. per stone for scutching, and produced a return in support of that statement.

Mr. Samuel Cupples produced a return showing that the scutching of 7,000 stones of flax in the season cost him 3s. 2d. per stone.

Mr. J. M'Kean said that without getting the tow he could not scutch flax for less than 3s. 6d. per stone.

Mr. Carville gave a detailed account of the working expenses of his mill, in which he invested £1,200. He had nine scutchers and they turned out 9,000 stones of flax in the season. He paid them 1s. 3d. per stone as wages. With £100 for himself as manager, and insurance, fire, light, &c., this left the total expenses at £1,105 16s. 5d. per year.

Mr. Ewart, Ards, said that in order to get a fair profit, owners could not scutch for less than 3s. 6d. per stone and let the farmer have his tow.

Mr. Jas. Boyd said that at present in the Kirkcubbin district of the County Down, 2s. 3d. per stone was charged for scutching and the millowner retained the tow.

Mr. Small, representing Loughbrickland Farmers' Association, said that they had established a mill and were going to scutch the flax at 3s. per stone, and scutch the tow for the farmer as well.

Mr. Dologhan stated that in Sir Robert Liddell's new mill at Donacloney, the charge was 2s. 9d. per stone and the farmer got his tow.

Sometimes the charge for scutching includes, say, 2d. for insurance.

Several co-operative scutch mills have been established by bodies of growers who were dissatisfied with the system of letting the scutchers keep the tow.

Farmers would like to have their tow scutched directly after the flax; millowners, however, would prefer to keep it until the end of the season and then scutch it.

Mr. John Jeffers believed that if there were better streaking and rolling in mills there would not be so much tow.

SCUTCHING TOW QUESTION.

In the olden days when flax scutching tow was only worth £12 to £18 per ton, the scutch mill-owner charged the farmer only a small fee, say 1s. 6d. to 1s. 9d. per stone for scutching and kept the tow produced. At the present time, however, when tow is worth from £80 to £100 per ton, the grower is naturally anxious to realize all he can on his own produce and refuses to be put off with the tow allowance made in the years when scutched flax only fetched 6s. to 7s. per stone in the market.

From evidence given before a committee appointed by the Department of Agriculture to inquire into the charges for scutching and the disposal of tow it would seem that the actual cost of scutching was in 1917 approximately 3s. 3d. per stone, of which the operative scutcher got 1s. 3d. as wages. The charge made for scutching the rug is approximately 20s. per cwt. In 1917, the market value of rug was 20s. per cwt., and fine tow 45s. per cwt., and targed or rescutched tow or rug 75s. per cwt.

RUSSIA'S LINEN TRADE.

Russia is the great flax-producing country of Europe. There it is grown to some extent in almost every government of that great Empire both in Europe and in Asia and more particularly in Pskoff, Smolensk, Vologda, Kostroma, Livonia, Vladimir, Vitebsk and Viatka.

The various branches of the linen trade, from raising the plant to weaving the linen, occupy the first rank among the textile industries of Russia. On the banks of the Volga and in Yaroslav and Kostroma many flax spinning mills have been erected, while power loom weaving has made great progress in Vologda, Vladimir, Kostroma, Yaroslav, Novgorod, Tiver and Archangel. Yaroslav is famed for its fine linen made in imitation of Irish goods; Kostroma for fine linen and damask and Vladimir and Novgorod for duck and sheeting.

Russian flax is principally grown in the north, and it is the chief crop and source of revenue to farmers and peasants. Russia is the largest flax producer in the world, nearly 41,000,000 acres being sown.

Two processes of retting are carried out, namely, dew-retting and water-retting. That coming from Archangel is dew-retted, and is usually of a silver-blay or reddish foxy colour.

Water-retting is practised in the west and north-west districts. Dew-retted is produced in larger quantities than water-retted. France is the largest importer of dew-retted fibre.

Russian spinners use home-grown flax almost entirely, their consumption being about 40,000 tons, or one-fifth of the total output of the country, which exceeds 200,000 tons annually.

The Russian Government takes the keenest interest to promote the prosperity of the flax industry. It has established experimental farms and propagates the best brands of seed, and gives instruction in the most modern methods of flax culture.

Their peasants bring their flax to market in the winter time when the roads are covered with snow and in good order for the sledges. Since the lots are rather irregular in quality, classers attached to the market separate the various qualities and put a price upon the lot. It is then sold to small agents, often Russian Jews, who resell it to export houses.

To prevent dishonest dealing the flax bundles must not exceed 10 lb. in weight, must be only tied once in the centre with flax, so that the fibre may be examined without loosening the bundles. They must only be composed of fibre of same quality and scutched to the same degree. Any person guilty of selling flax containing tow or other foreign matter, or delivering damp flax fraudulently, is liable to punishment. Inspectors are appointed.

Riga flax is exported in mats weighing about 1 cwt., with a tare allowance of 3 lb. per mat. Other flaxes are exported in bobbins or bundles without matting, and weighing rather more than 1 cwt. Gospodsky is flax grown by a Russian noble, or taken by him as toll from the peasants, and usually fetches a high price owing to its better cultivation and handling. Archangel flax is exported in bales weighing each about 500 lb. Zins is the name of a flax upon which is levied tax money for the Church, which took the best flax called Zins.

Official public bracking (sorting or grading) of flax in Riga is a very ancient law, and flax which has not been bracked cannot be exported. If flax was not scutched to the proper standard of the various grades, the grower had to take it back and re-scutch it. No merchant is allowed to keep any of the middle grades, as these are kept under seal by the authorities, so that he is unable to blend the various grades, as the difference between the high and low grades is marked he could not risk doing so. This gave foreign spinners a guarantee for absolutely reliable deliveries.

THE BRITISH FLAX AND HEMP GROWERS' SOCIETY.

This Society, which was started some years ago to take over Mr. Philip Middleditch's hemp farm at Prickwillow, and whose object is to extend flax and hemp cultivation in the United Kingdom, does not seem to be self-supporting, but receives periodical grants from the Development Commissioners. To help the Society they have, according to their Seventh Annual Report, recently issued, made two further grants to the Society—£4,575 to meet expenses during the six months to September 30, 1916, and £6,275 to meet expenses during the following year. The Society has thus been financed for several years to enable it to ascertain whether flax can be grown in Great Britain with profit to the growers. Flax is cultivated in selected districts. Experimental retteries have been established at Selby and Yeovil, and experiments made in the production of fibre and seed of improved strains. Owing to the War they have brought about the cultivation of increased areas of flax in Yorkshire, Somerset and Dorset, and will do so in Scotland next year. It is to be hoped that enhanced prices will cause an extensive reduction in the cost of their experiments.

FLAX CULTIVATION IN ENGLAND.

The general method of cultivation in England is as undermentioned :—

The land for flax cultivation is rented from the farmers by either a company or privately. There is a contract made between the two parties: that the farmer who offers the land has to plough and cultivate the ground in preparation of the seed-bed, and when the crop is harvested it is delivered at the nearest railway station or at the rettery belonging to the parties connected. The parties renting the land, enabling him to get in the flax crop, supplies the seed for sowing, so the weeding and pulling, and finally takes delivery of the straw when harvested. Afterwards the seed is taken off the straw during winter, and the straw retted the following summer, which results in the fibre being held a year over.

The farmers not having accommodation or retting facilities, a rettery is established. Where the flax is grown in the district very often the straw is artificially retted, as the water supply for natural retting is not available.

The handling and scutching of the flax is carried on much after the same principle as in Ireland.

In Ireland the flax grower remains generally the owner of his product through all its stages, and having full knowledge of the suitability of his land for flax cultivation and careful treatment of the crop throughout, such as cultivating while the ground is dry, weeding, proper stage of pulling, retting, &c., he gains the full advantage of his crop, whereas in England the middleman comes in for his share between producer and consumer.

AN APPEAL TO THE FARMERS OF IRELAND TO GROW MORE FLAX.

Particularly those in Munster, Leinster and Connaught.

The soil and climate of Ireland are the best in the world for the growing of flax.

Before the Irish started the cultivation, Belgium and France had supplied the markets of the world. But after we commenced, we were able, I understand, to export large quantities to Great Britain. So prosperous and well-established had it become that in 1828 the Government withdrew its annual grant.

In 1809 the flax grown in Munster, Leinster and Connaught was nearly 15,000 Irish acres, which in 1823 had increased to nearly 50,000 acres. Now it is almost nil.

Why has there been such a decline? Several reasons might be given, viz., low prices, scarcity of labour, &c. The farmers of those provinces, I daresay, are as anxious to make money as are the farmers in Ulster. I am sure I need only have to call attention to the splendid return from last season's crop and the present one in this province.

In the Journal of the Department of Agriculture, I understand, numerous instances appeared where farmers, scattered over Ulster, had last season realized, even with the low yield, over £30 an acre; while this year this will easily be surpassed. In some cases nearly £40 have been already received. Are not these tempting prices to any farmer? From what other crop could he obtain anything to equal it? Would cattle give such a return?

The sowing of this crop has many material advantages. Let me enumerate a few:—

(1) It will increase the wealth of the farmer more quickly than any other crop.

(2) It gives employment to a far larger number of workers than does the produce of any other crop.

(3) It retains more labour in a district available for the farmer in the spring, summer, and autumn, as in the winter the same hands can be employed in scutching; then they get a whole year's continuous employment.

(4) The scutchers' wages range from 18s. to 24s. a week; while streakers, with rolling man, or woman, are paid less in proportion. Women and girls as a rule do the streaking or handfulling, so that both male and female labour is employed.

(5) The erection of scutch mills would help to raise more revenue for rates and taxes.

(6) A reasonably extensive sowing of flax in a district would open up new markets for its sale. Flax buyers would attend these markets, and thereby create a large circulation of money.

In Coleraine market, held on November 2 of this year, there were over £6,000 paid for scutched flax; this is going on every week for several months. Is it any wonder the Derry farmers are so comfortable and well-to-do!

(7) Flax, not having been sown outside Ulster for practically half a century, would be grown on virgin soil in the other provinces, which is needed to produce flax of a superior quality.

(8) The bows or seed pods make an invaluable feed for cattle, if not otherwise preserved for sowing.

These are only a few of the many advantages to be derived from the growing and handling of this crop. When extensively grown, spinning mills, weaving factories, and bleach works, with kindred other industries will spring up into existence, bringing in their train a new era of contentment to our land.

Belgium was a wealthy country before the devastating War. What made it so? When flax here was selling at 5s. to 10s. a stone, it was selling on the Continent from 30s. to 40s. a stone. Why is this? The Belgians used their intelligence, and turned out an article superior to ours. What a splendid example of what can be done when enterprise and skill is properly directed!

I, therefore, hope to hear in a short time that all our farmers in Ireland have become growers of flax. There are said to be about 500,000 farmers in Ireland, and if each only sowed one acre we should increase our present area tenfold. What a splendid opportunity for the South and West!

DAVID M'MORDIE.

"NUMBER OF HANDLES ON THE ROUND."

The number of handles on the round which is to be most recommended has always been a debatable question: the general rule being that whatever number happened to be on a particular mill, that number, of course, was bound to be the best. There are strong advocates for all styles—5, 6, 7 and 8 on the round—and for so far nothing has been definitely proved. I think that in considering the merits of a mill it is necessary to consider the diameter of the scutching circle equally as much as the number of handles. Take a mill measuring 6 ft. diameter from point to point of scutching handles. You have a circumference of 18 ft. (it is not necessary to go into fractions), and with 6 handles on the round there will be 36 in. between each scutching edge. Take another mill, measuring 7 ft. diameter, with 7 handles on the round, and you have the same 36 in. between each scutching edge, and practically the same mill. But take a 6 ft. diameter with 7 handles—the same diameter with 8 handles—and you will have only a distance between each scutching edge of about 31 and 27 in. respectively. It seems to me that 36 in. between scutching edges is about the proper standard, as this space allows the stutched piece to "rise," or, as I might say, shake itself out in preparation for the next "bat," which is consequently much more effective. With the smaller space between the scutching edges the flax is covered continually by the handles. It has not got room to "rise." The handles are not as effective as they should be, and it is more of a "rubbing" than a "scutching" business. Every stalk has to be in direct contact with the handles, requiring much more handling by the operator, and the finished piece, instead of being whole in the fibre and well "closed," will be considerably broken and "spongy."

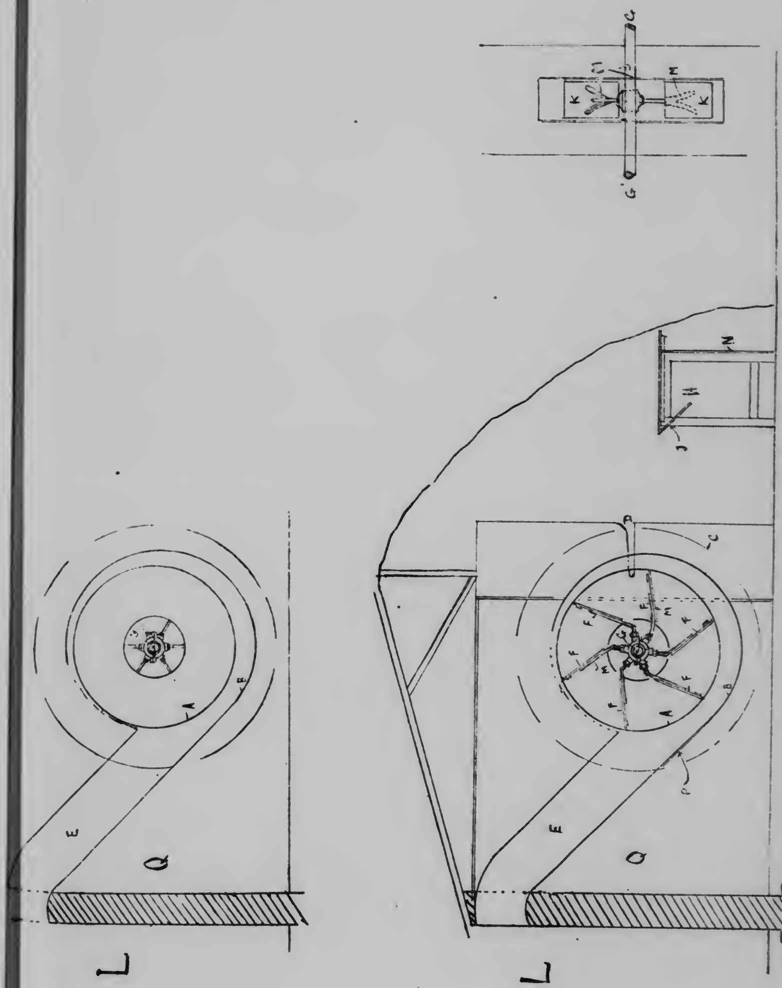
Apart from the number of handles on the scutching rim, a most important thing is the proper setting of both stocks and handles.

THE VENTILATION OF FLAX SCUTCH MILLS.

The ventilation of flax scutch mills is usually effected by fans placed in the walls of the partitioned-off shove chamber behind the stocks and handles.

A centrifugal fan (blower type) connected up with a collecting tube is, however, much more effective than extracting fans of the Blackman type placed in the walls or roof.

The figure shows the Courtrai plan of scutch mill ventilation which has been found to be both cheap and effective. A is the circular path of the tips of the fan blades F and K, pieces of board attached to the forked arms projecting from the boss G keyed upon the rim or circle shaft. These blades revolving clockwise draw in the dust through the circular intakes at each side around the shaft and 16 in. in diameter, and expel it through the outlet pipe E, 14 in. in diameter, which must be smooth. The tips of the fan blades should pass as close as possible without touching to the upper junction of the outlet pipe and the circular casing, which is slightly eccentric, to the revolving shaft and fan. There is a passage at Q underneath the outlet pipes to remove tow and an inspection door at the lower junction of the outlet pipe and fan casing. The fan blades may conveniently be of seasoned beech, $12\frac{1}{2}$ in. wide and 17 in. long. The casing is of $\frac{1}{8}$ in. sheet steel and $13\frac{3}{4}$ in. wide. The distance apart or pitch of each set of scutching blades is 33 in. and the fan is placed on the shaft exactly between two of them, there being one fan for every three handles. The shaft and the fan make 230 revolutions per minute. S is a baffle-board attached to the flax table to keep the draught produced by the handles down; while N is sheeting hinged on sliding doors which may be fitted at the back side of the flax table. The fan casing and outlet pipe may be of $\frac{1}{2}$ in. wood sheeting tongued and grooved, in which case the outlet pipe may be of square section.



Method of Flax Scutch Mill Ventilation.

The removal of the dust produced in rolling or crushing the flax straw by means of fluted rollers is best secured by filling in the framing of the machine with wood or sheet iron so as to make it air-tight; the only places where air can enter being between the pairs of rollers, i.e., just where the dust would issue were the machine not connected up with an extracting fan. Occasionally the dust is removed by suction, operating through a hood or hoods placed over the top of the rollers, but the downward draught is to be preferred.

In country mills, the dust may usually be discharged directly into the atmosphere, as it does little harm if the mill is not in close proximity to a dwelling house. If discharged in this way, the fan outlet should not face the direction whence comes the prevailing wind lest free discharge of the fan should thereby be obstructed, the usual fan being incapable of overcoming much resistance of that sort.

Should the position of the mill be such as to render the dust blown out by the fans a source of nuisance, a cyclone dust separator and settling chamber must be provided, or other means adopted to smother the dust at once, such as the projection of the dusty air into a stream of water. If blown into the open air it must be carried well away from any inlets lest it be again carried into the building.

The cyclone separator, above referred to, is constructed in such a way that the heavy waste falls downwards into a chamber, while the air escapes from the upper portion.

It is probable that a cyclone separator would pay for itself sooner or later in saving saleable fibre which would be lost were it blown out into the open air.

FLAX-PULLING MACHINES.

None have so far proved a practical success. Perhaps the most promising is an American invention (Whittaker and Previsto). This machine is said to pull a width of 3 ft., clean the roots, lay the stems parallel, tie them in bundles and throw these beets to one side. Its capacity is stated to be 10 acres a day, using one pair of horses and a man in addition to the small auxiliary oil engine there is on the machine.

VISIT TO THE SELBY FLAX STATION.

The ground around the works is used for drying the retted straw in steeple form.

Entering the works we found a number of men and girls deseeding dry straw and bundling it up again for retting in handy presses. The deseeding machine used was of the roller type as elsewhere described. The crushing, sieving and winnowing of the bolls followed, the clean seed being bagged up and the husks burned.

The treatment of the retted and dried straw was next witnessed. An eight-pair set of flax rollers of continental make was used, chiefly differing from Irish rollers in the application of thrust screws to the roller ends. The rolling, stricking and scutching was done by girls, who, wearing a glove in the holding hand, seemed to have been well taught and to be skilful. The straw being well retted was easily cleaned by blades or handles of the light Belgian type, that part of the mill fitted with Irish handles and stock being seemingly unused. Loose fibres were pulled from the ends of the strick by hand, end combs and touch pins being conspicuous by their absence. The scutch mill was ventilated, apparently satisfactorily, by blower fans of the Belgian type, fixed upon the rim shaft and arranged as we have just described.

We were next taken to the retting dam and tanks, the former a branch of the River Ouse, or adjoining canal in which the rate of current was regulated to ½ in. per minute or less than one yard per hour, a very much slower current than that of the Lys. Otherwise Lys methods were followed, the straw being built into openwork crates which were lowered into and raised from the river by well-arranged rack and pinion lifting gear, being floated to and from their retting positions in the pond.

The retting tanks were of cemented concrete and in depth equal to one layer of straw on end only, which was just as well, seeing that the heavy beets of wet straw had to be pitchforked out over the edge. The straw rested upon a false bottom over channels communicating with hollow outside buttresses serving as overflows and which carried off the heavy brown acid juices of fermentation. Downward currents were produced by intermittent flushes of water evenly distributed by means of perforated wooden gutters. The water was intermittently supplied in flushes so as to ensure the equal filling of the gutters, which could not be produced by the same amount of water flowing constantly. The flush was produced by an ordinary sanitary cistern. The water was heated to a temperature of about 70° F., and pumped into an overhead storage tank, whence it ran to the flush cistern through a hole of adjustable size, according to the rate of flow required. A uniform temperature was maintained during the night by a gas heater through which the water passed, the gas being turned on and off by the action of a thermostatic valve.

We were led to suppose that the cost of retting and drying thus carried out amounted to 16s. per ton of retted straw.

We next witnessed a demonstration of Mr. Wilkinson's impact testing machine, specially designed to replace the experience necessary to successfully judge the comparative strength of flaxes and the results of various methods of retting and season's growths. In this machine a bundle of untwisted fibres, say ¼ to ½ in. diameter, but of the exact section of the opening in the clamps provided to hold it, is clamped so as to leave a few inches tightly held between the clamps. A heavy lead-loaded pendulum-hammer was swung directly overhead and raised to a given height and allowed to swing downwards in the arc of a circle, striking and breaking through the bunch of fibres on its way. The motion which it loses represents the force required to break this bunch of fibres, and is measured by the difference in the length of the arc swung through on each side of the vertical line passing through the point of suspension of the hammer and the bunch of fibres below. If no resistance was offered, the length of the arc would practically be the same, and the difference in their lengths is directly as the resistance offered or the strength of the fibre. The height to which the hammer swings after passing through the fibre is indicated by a pencil or point upon a piece of indicator paper suitably placed.

We were also interested in samples showing the resultant quality of the same flax pulled green, half ripe, and fully ripe, also in the increased length, say 9 in., of flax grown from Professor Bateson's selected seed as compared with that grown from the best ordinary seed.

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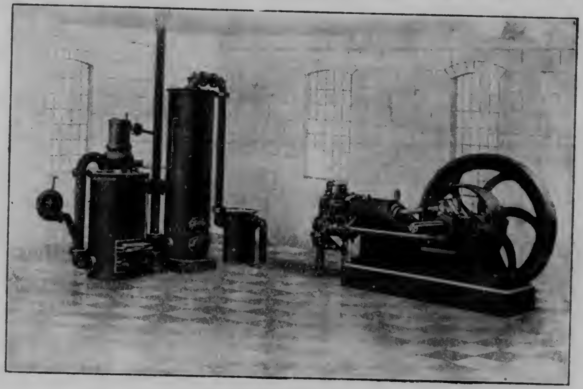

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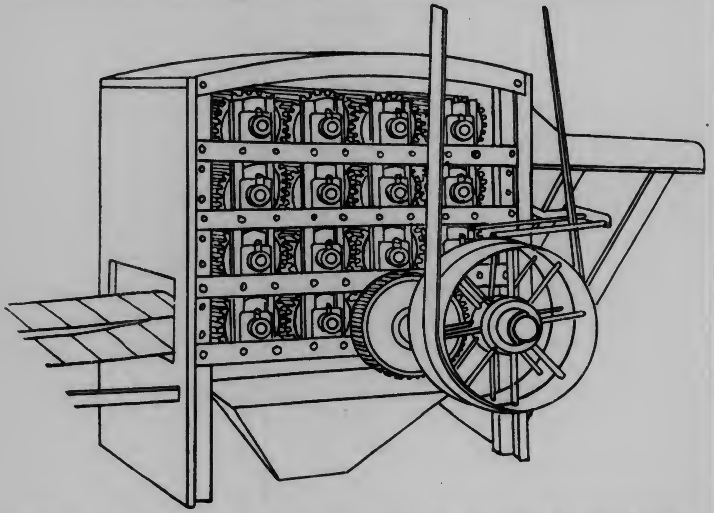

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